

## Addison County Riverwatch Collaborative

28 February 2011

Jim Kellogg  
Water Quality Division  
Biomonitoring and Aquatic Studies Section  
103 South Main Street  
Waterbury, VT 05671-0409

Re: Addison County Riverwatch Collaborative 2010 Summary Report

Dear Jim:

Attached is the 2010 Summary Report from the Addison County Riverwatch Collaborative. Attachments 1 through 6 in the report summarize the results on a single page for each of the six watersheds monitored by our group. We intend to utilize these as handouts in future outreach to relevant towns and watershed stakeholders.

The Collaborative is most grateful for the technical and logistical support from Ethan Swift, and for the analytical services of LaRosa Laboratory that enabled us to carry out monitoring in 2010. We are encouraged by the new Vermont Surface Water Management Strategy and the focus on data-driven tactical basin plans to identify and prioritize protection and restoration strategies for our rivers. We are hopeful that our data will continue to be used for prevention, mitigation and planning purposes by the VTDEC and its partners in water quality stewardship, including the Agency of Agriculture and VTrans.

The Collaborative is concerned that Lemon Fair River has not been listed on the 303D list of impaired waters, while water quality results available since 2004 indicate chronic exceedances of VT Water Quality Standards for E. coli and Turbidity. Mean low-flow concentrations of Phosphorus and Nitrogen exceed the newly proposed instream nutrient criteria suggesting possible impacts to aquatic life support and aesthetics uses in these water bodies. Lemon Fair River was listed on *Part C – List of Waters in Further Need of Assessment* in 2004 (sediment, nutrient and E.coli impacts to AES, ALS, CR due to agricultural runoff, streambank erosion and loss of riparian vegetation). It then disappeared from the Part C list in 2006 and 2008 and was not listed on the 303D of impaired waters for either of those subsequent years.

We would appreciate any insight you can offer regarding the status of the Lemon Fair. We are also very interested in how our data are being used by VTANR and its partner agencies, and look forward to a discussion or reporting of this information.

Sincerely,

Heidi Willis, Coordinator

Cc: Ethan Swift, VTDEC, [ethan.swift@state.vt.us](mailto:ethan.swift@state.vt.us)  
Neil Kamman, VTDEC, [neil.kamman@state.vt.us](mailto:neil.kamman@state.vt.us)

Summary Report: 2010 Sampling Results  
Addison County Riverwatch Collaborative

25 February 2011

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Prepared for:  
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VTDEC Water Quality Division

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Appendix A – Quality Assurance Summary

Appendix B - Data Tables by Watershed

### Attachments

- 1 Lemon Fair River – 2010 Water Quality Summary
- 2 Lewis Creek – 2010 Water Quality Summary
- 3 Little Otter Creek – 2010 Water Quality Summary
- 4 Middlebury River – 2010 Water Quality Summary
- 5 New Haven River – 2010 Water Quality Summary
- 6 Otter Creek (Lower) – 2010 Water Quality Summary

## **1.0 Introduction**

This report provides a brief summary of the 2010 sampling results for the Addison County Riverwatch Collaborative (ACRWC). Sampling was carried out by a network of volunteers, with logistical and technical support provided by Ethan Swift of the VTDEC Monitoring, Assessment and Planning Program and Kevin Behm of the Addison County Regional Planning Commission. Analytical services were provided by the LaRosa Analytical Laboratory in Waterbury, VT, through an analytical services partnership grant.

The reader is referred to a series of water quality reports prepared by Dr. Bill Hoadley in 2009 for an analysis of historical water quality results in each of these watersheds. This summary report is intended to be a brief synopsis of the 2010 season, with reference to these more technical reports for historical context and trend analysis.

Section 6.0 provides a one-page summary of sampling results for each of the ACRWC watersheds. These summaries are formatted to serve as a one-page handout for each watershed that can be distributed to the public in relevant towns.

## **2.0 Background**

The ACRWC has been monitoring water quality (including sediment, phosphorus, nitrates, and E.coli) in six watersheds in Addison County (Figure 1) for more than a decade, with the earliest monitoring efforts beginning in 1992:

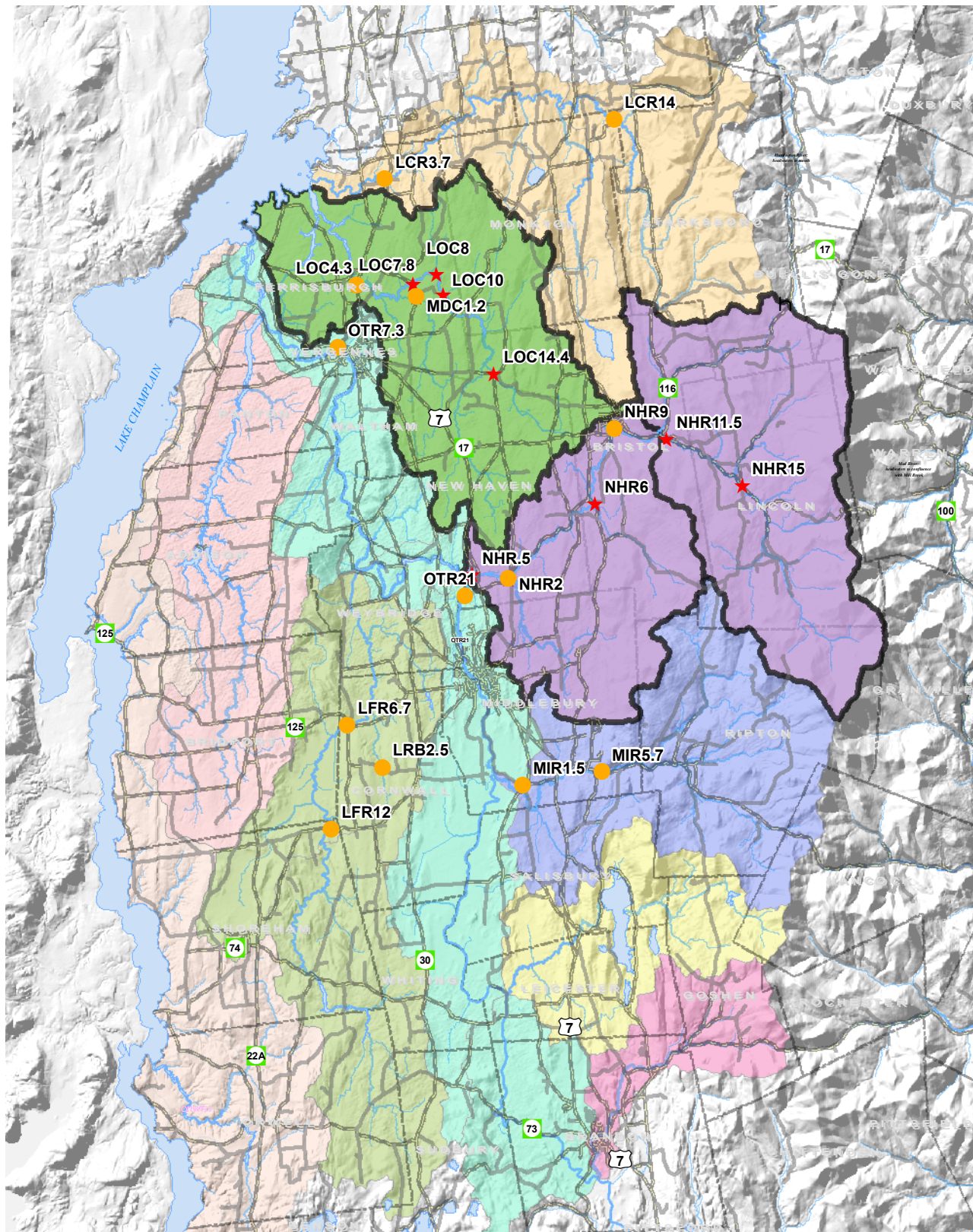
- Lemon Fair River (2003 – present)
- Lewis Creek (1992 – present)
- Little Otter Creek (1997 – present)
- Middlebury River (1993 – present)
- New Haven River (1993 – present)
- Otter Creek (1992 – present)

During a hiatus from sampling in the 2009 season, the ACRWC conducted a programmatic review of their water quality monitoring goals and objectives, and met with various state and regional groups to identify opportunities for collaboration and data sharing. With input from Dr. Bill Hoadley (2009 Draft Water Quality Reports), historical sample results and trends were analyzed to refine the overall sampling design for each of these six watersheds, in light of updated goals and objectives.

Since several years of baseline data now exist for the six ACRWC watersheds, the sampling schedule was revised, beginning with the 2010 season, to include longer-term trend monitoring at a reduced number of key sites in each watershed (sentinel sites) with a reduced number of water quality parameters. These sentinel sites are to be combined with a more focused monitoring effort in two of the six watersheds that will rotate for a period of two years on and four years off (Table 1). The focused evaluation will involve a greater number of sites (and testing parameters) than the sentinel sites, and will be conducted to meet specific data needs of relevance to the chosen watershed.

# Addison County Riverwatch Collaborative

## Water Quality Monitoring Sites by Watershed, 2010



- ★ Rotation Basin Site 2010
- Sentinel Site
- Little Otter Creek
- New Haven River

- |  |   |  |
|--|---|--|
| <ul style="list-style-type: none"> <li><span style="background-color: orange; display: inline-block; width: 10px; height: 10px;"></span> Lake Champlain direct</li> <li><span style="background-color: lightorange; display: inline-block; width: 10px; height: 10px;"></span> Lewis Creek</li> <li><span style="background-color: green; display: inline-block; width: 10px; height: 10px;"></span> Little Otter Creek</li> <li><span style="background-color: lightgreen; display: inline-block; width: 10px; height: 10px;"></span> Otter Creek</li> <li><span style="background-color: purple; display: inline-block; width: 10px; height: 10px;"></span> New Haven River</li> </ul> | <ul style="list-style-type: none"> <li><span style="background-color: pink; display: inline-block; width: 10px; height: 10px;"></span> Dead Creek</li> <li><span style="background-color: lightgreen; display: inline-block; width: 10px; height: 10px;"></span> Lemon Fair River</li> <li><span style="background-color: yellow; display: inline-block; width: 10px; height: 10px;"></span> Leicester River</li> <li><span style="background-color: blue; display: inline-block; width: 10px; height: 10px;"></span> Middlebury River</li> <li><span style="background-color: magenta; display: inline-block; width: 10px; height: 10px;"></span> Neshobe River</li> </ul> | <b>Roads</b><br><ul style="list-style-type: none"> <li><span style="border-bottom: 2px solid black; display: inline-block; width: 20px;"></span> Pavement</li> <li><span style="border-bottom: 1px solid black; display: inline-block; width: 20px;"></span> Gravel</li> </ul> |
|--|---|--|

0 0.5 1 2 3 4 5 Miles

The Addison County Riverwatch Collaborative is a citizen organization whose mission is to collect and assess the water quality of Vermont surface waters, and to facilitate water quality and stream corridor improvement measures on a watershed scale.

*Table 1. Rotational Schedule for Focused Monitoring*

2010-2011	2012 – 2013	2014 - 2015
Little Otter Creek	Lewis Creek	Middlebury River
New Haven River	Lemon Fair	Otter Creek

Beginning with the 2010 sampling season, Little Otter Creek (including Mud Creek) and New Haven River were selected to be focus watersheds (Figure 1, watersheds in bold outline). Therefore, rotational sites were scheduled for sampling in addition to the sentinel sites in these two watersheds. Table 2a displays the schedule of sampling sites and parameters for the 2010 season; “R” denotes a rotational site, “S” for a sentinel site.

At the request of VTDEC and LaRosa Laboratory, the number of sampling sites and parameters was further reduced, beginning with the June event – due to budgetary constraints. Therefore, a different schedule of sampling sites and parameters was developed for Spring months (April, May) versus the Summer months (June, July, August, September).

As a result of 2009 scoping meetings with VTDEC, and consistent with updated goals and objectives for the ACRWC monitoring program, a flow study was undertaken in 2010 in the Little Otter Creek watershed and will continue into 2011. A 2010 schedule of sampling sites and parameters for the flow study is presented in Table 2b.

### **3.0 Methods**

Water quality samples were collected by ACRWC volunteers in accordance with quality assurance procedures outlined in the EPA-approved Generic Quality Assurance Project Plan prepared by VTDEC. Appendix A provides a detailed Quality Assurance Summary for the 2010 sampling results.

During 2010, ACRWC volunteers collected grab samples at 20 sites in these six watersheds during two Spring events (April and May) and four Summer events (June, July, August and September). Sampling dates were pre-determined as the first Wednesday of each month, and were not designed to capture any specific flow condition. During the Spring events, some watershed sites were sampled on the previous day (see Appendix A for details).

- April 6/7
- May 4/5
- June 2
- July 7
- August 4
- September 1



Table 2a. 2010 Schedule of Sites / Parameters – Spring and Summer

Project Name: Addison County River Watch Collaborative

Project Number: 137-01

Sample Year: 2010				Spring Schedule (Apr, May)							Summer Schedule (Jun, Jul, Aug, Sep)						
Type	River Name	Site ID	Site Location	PARAMETERS							PARAMETERS						
				E.coli	TP	DP	TN	NOx	Turbidity	TSS	E.coli	TP	DP	TN	NOx	Turbidity	TSS
S	Lewis Creek	LCR3.7	Old Route 7 Bridge		X				X		X	X				X	
S	Lewis Creek	LCR14	Tyler Bridge		X				X		X	X				X	
S	Lemon Fair River	LFR6.7	Route 125 bridge. (temporarily replaced by LFB2.5 during bridge construction)		X		X		X		X	X		X		X	
temp	Lemon Fair River	LFB2.5	Beaver Branch, a trib up from Rt 125 bridge														
S	Lemon Fair River	LFR12	Downstream of Route 74 bridge		X		X		X		X	X		X		X	
R	Little Otter Creek	LOC14.4	Plank Rd.		X	X	X		X	X	X	X	X	X		X	X
R	Little Otter Creek	LOC10	Monkton Road		X	X	X		X	X	X	X	X	X		X	X
R	Little Otter Creek	LOC8	Wing Rd bridge		X	X	X		X	X	X	X	X	X		X	X
R	Little Otter Creek	LOC7.8	Middlebrook Rd (North)		X	X	X		X	X	X	X	X	X		X	X
S	Little Otter Creek	LOC4.3	Route 7 Bridge		X	X	X		X	X	X	X	X	X		X	X
S	Mud Creek	MDC1.2	Wing Rd./Middlebrook Rd. (South)		X	X	X		X	X	X	X	X	X		X	X
S	Middlebury River	MIR1.5	Shard Villa Rd. Bridge		X				X		X	X				X	
S	Middlebury River	MIR5.7	Midd. Gorge @ Rte 125 Bridge		X				X		X	X				X	
R	New Haven River	NHR.5	Dog Team Tavern		X				X		X	X				X	
S	New Haven River	NHR2	Mud Creek confluence		X				X		X	X				X	
R	New Haven River	NHR11.5	Bartlett's Falls Pool		X				X			X				X	
R	New Haven River	NHR15	S. Lincoln Bridge (Gap Rd.)		X				X			X				X	
R	New Haven River	NHR6	Route 116 Bridge, Sycamore Park		X				X		X	X				X	
S	New Haven River	NHR9	South St. Bridge		X				X			X				X	
S	Otter Creek	OTR21	Belden Falls		X		X		X		X	X		X		X	
S	Otter Creek	OTR7.3	Vergennes Falls/below outfall		X		X		X		X	X		X		X	

Site Types: R = Rotational; S = Sentinel

ACRWC 2010 sampling dates were: Spring: April 6/7, May 4/5; Summer: June 2, July 7, August 4, September 1

No E.coli samples were collected during Spring events (April, May), only during Summer events (June, July, Aug, Sept)

*Table 2b. 2010 Schedule of Sites / Parameters – Flow Study*

Project Name: Addison County River Watch Collaborative

Project Number: **137-01**

Sample Year: <b>2010</b>				Flow Study						
Type	River Name	Site ID	Site Location	PARAMETERS						
				<i>E.coli</i>	TP	DP	TN	NOx	Turbidity	TSS
S	Lewis Creek	LCR3.7	Old Route 7 Bridge							
S	Lewis Creek	LCR14	Tyler Bridge							
S	Lemon Fair River	LFR6.7	Route 125 bridge. (temporarily replaced by LFB2.5 during bridge construction)							
temp	Lemon Fair River	LFB2.5	Beaver Branch, a trib up from Rt 125 bridge							
S	Lemon Fair River	LFR12	Downstream of Route 74 bridge							
R	Little Otter Creek	LOC14.4	Plank Rd.		X	X			X	
R	Little Otter Creek	LOC10	Monkton Road		X	X			X	
R	Little Otter Creek	LOC8	Wing Rd bridge							
R	Little Otter Creek	LOC7.8	Middlebrook Rd (North)		X	X			X	
S	Little Otter Creek	LOC4.3	Route 7 Bridge							
S	Mud Creek	MDC1.2	Wing Rd./Middlebrook Rd. (South)							
S	Middlebury River	MIR1.5	Shard Villa Rd. Bridge							
S	Middlebury River	MIR5.7	Midd. Gorge @ Rte 125 Bridge							
R	New Haven River	NHR.5	Dog Team Tavern							
S	New Haven River	NHR2	Mud Creek confluence							
R	New Haven River	NHR11.5	Bartlett's Falls Pool							
R	New Haven River	NHR15	S. Lincoln Bridge (Gap Rd.)							
R	New Haven River	NHR6	Route 116 Bridge, Sycamore Park							
S	New Haven River	NHR9	South St. Bridge							
S	Otter Creek	OTR21	Belden Falls							
S	Otter Creek	OTR7.3	Vergennes Falls/below outfall							

Site Types: R = Rotational; S = Sentinel

ACRWC 2010 flow study sampling dates were: Sept 29, Oct 1, Oct 2, Oct 4



In the focus watershed, Little Otter Creek, the flow study was designed to rely on Spring and Summer sampling results from the ACRWC program for select stations, as well as separate samplings of storm events which occur outside the regular ACRWC monitoring schedule. One such event was monitored between Sept 29 and Oct 4 of 2010. Four grab samples were collected at each of three stations during this event to monitor changes in concentrations of Total Phosphorus, Dissolved Phosphorus, and Turbidity through the storm hydrograph. A summary of this flow study will be reported under separate cover.

Climate and flow data were compiled from existing weather stations and USGS gaging stations in vicinity of the ACRWC watersheds.

#### 4.0 Climate

Calendar year 2010 was a somewhat wetter-than-normal year, due in part to greater-than-normal monthly rainfall totals in June and October, as recorded at regional weather stations in South Burlington (Airport), Rutland, and South Lincoln, Vermont. Snowfall in the winter of 2009–2010 was somewhat less than normal as recorded at the Burlington Airport, but much less than normal in the higher elevations, as recorded at the South Lincoln, VT weather station (NOAA Online Weather Data, accessed Feb 2011). Ice-out occurred relatively early in the Addison County watersheds – on January 25-26, 2010.

The September 30 / October 1, 2010 storm event monitored in the Little Otter Creek represented a significant event in the six ACRWC watersheds. “On September 30<sup>th</sup>, an area of low pressure moved north through the mid Atlantic states. Southerly flow ahead of the low tapped into deep tropical moisture, including moisture associated with the dissipated remnants of Tropical Storm Nicole. Heavy rain spread into Vermont late on September 30<sup>th</sup> and continued [on] October 1<sup>st</sup>,...” (National Climatic Data Center, 2011)”. Table 3 summarizes the rainfall recorded at regional weather stations. Based on provisional data from the precipitation gage at USGS Gaging station #04282525 (New Haven River at Brooksville, near Middlebury, VT) and records for the weather stations in South Burlington, VT (Airport) and in Rutland, VT accessed at WeatherUnderground, rainfall was fairly widespread moving from west to east and ceased in the area of central Addison County at approximately 3 PM on October 1<sup>st</sup>. Immediately prior to this event, area rivers had been near baseflow conditions.

*Table 3. Precipitation at Regional Weather Stations from Sept 30 through Oct 1, 2010*

Precipitation Gage	Elevation (ft amsl)	Distance from center of Little Otter Creek watershed	Total Rainfall (inches)
New Haven River at Brooksville, VT (USGS Gage # 04282525) <sup>1</sup>	235	7.8 mi S	4.73
South Lincoln, VT <sup>2</sup>	1,370	13.6 mi SE	4.63
Burlington, VT (Airport) <sup>2</sup>	330	20 mi N	2.95
Rutland, VT <sup>2</sup>	620	40 mi SSE	4.05

<sup>1</sup> Provisional precipitation data, [http://nwis.waterdata.usgs.gov/vt/nwis/uv?site\\_no=04282525](http://nwis.waterdata.usgs.gov/vt/nwis/uv?site_no=04282525)

<sup>2</sup> NOAA Online Weather Data: <http://www.weather.gov/climate/xmacis.php?wfo=btv>

## 5.0 Hydrology

Four of the six watersheds sampled by the ACRWC, as well as nearby LaPlatte River, have USGS gaging stations which record instantaneous flow at fifteen minute intervals. Gages on Lewis Creek, Little Otter Creek, New Haven River, and LaPlatte River are near the downstream end of the main stem. Two gages on Otter Creek (at Middlebury and at Center Rutland) are located mid-watershed, at 66.5 % and 32.5 % of this 944 square mile basin, respectively.

Flow records are available for the past 20 years at Little Otter Creek, New Haven River, Lewis Creek and LaPlatte River gaging stations. Mean annual flows recorded at these stations over that time period are summarized in Table 4. While a considerably longer record exists for the two Otter Creek stations, the range of mean annual flows for the same 20-year time span is presented for these two stations in Table 4. Data are summarized by water year – which begins October 1<sup>st</sup> of the previous calendar year and extends through September 30<sup>th</sup> of the indicated year. Based on 20 years of record, mean annual flows in the ACRWC watersheds for water year 2010 were near average for Little Otter Creek, New Haven River and Lewis Creek, and somewhat above average for the Otter Creek stations.

*Table 4. Mean Annual Flows, 1991 – 2010, ACRWC and vicinity watersheds.*

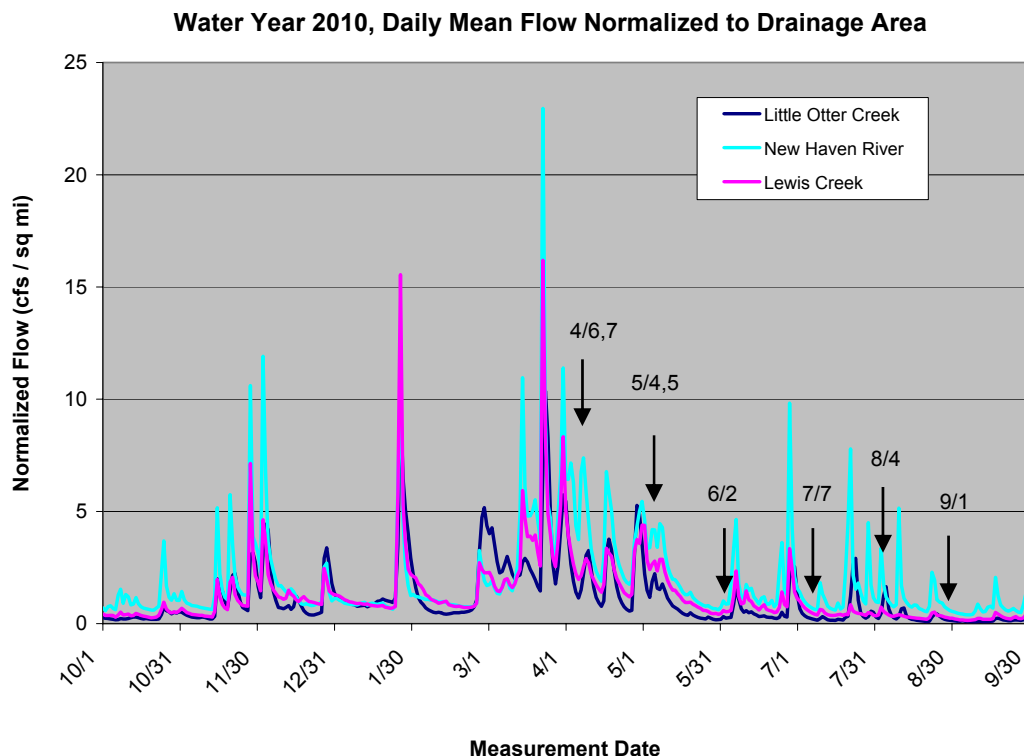
<i>Watershed</i>	Little Otter Creek		New Haven River		Lewis Creek		LaPlatte River		Otter Creek at Middlebury		Otter Creek at Rutland	
<i>Drainage Area (sq mi)</i>	73		116		81		53		944		944	
<i>Gaged Area (sq mi)</i>	57.1		115		77.2		44.6		628		307	
Min (1991-2010)	2002	27	1995	129	1995	54	1995	22	1995	672	1995	355
Max (1991-2010)	2008	106	2006	315	2006	166	2006	85	2006	1,489	2006	796
Mean (1991-2010)		64		213		105		50		1,141		595
Water Year 2010		<b>66</b>		235		<b>103</b>		47		1,280		<b>705</b>

*Note: Estimates for water year 2010 for highlighted values are calculated from provisional Daily Mean Flows, accessed 13 Feb 2011 online at: <http://waterdata.usgs.gov/vt/nwis/rt>*

Figure 2 presents mean daily flows in the Little Otter Creek, New Haven River and Lewis Creek. Flows have been normalized to gaged drainage area. Generally, New Haven River tends to exhibit more flashy flows, and often has a somewhat higher flow per unit area than the Lewis Creek and Little Otter Creek.

Spring sampling dates (April 6, 7 and May 4, 5) coincided with moderate to low flows in area rivers where overall flows were on the decline following earlier spring rains and snow melt (Figure 2). It is likely that early leaf-out conditions and increased evapotranspiration rates with warming temperatures also contributed to overall declining trends in streamflow during the April and May sampling events.

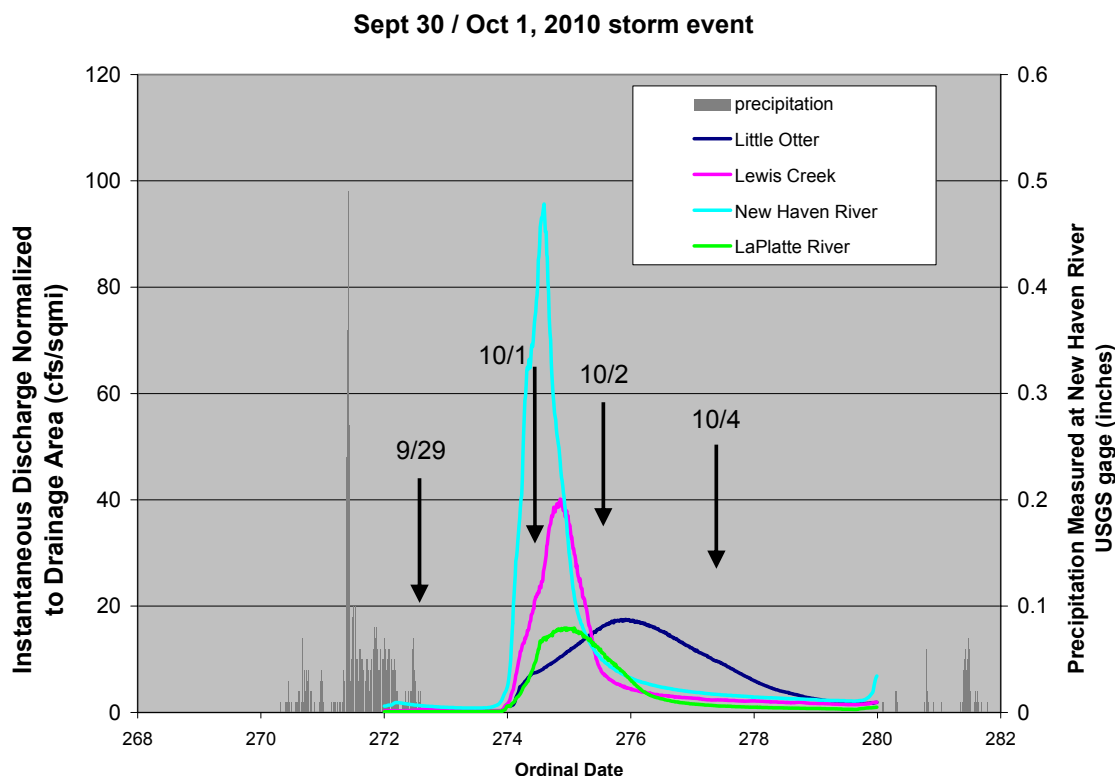
Summer sampling dates (June 2, July 7, August 4, and September 1) generally coincided with low to base flow conditions (Figure 2). Days immediately preceding the June and September sampling dates were dry. Rainfall totaling 0.41 inch (as recorded at Burlington airport) occurred on June 1, one day prior to the June sampling date. A total of 1.12 inches fell over a three-day period preceding and including the August 4 sample date.



*Figure 2. ACRWC Spring and Summer Sampling Dates relative to Mean Daily Flows normalized to Gaged Drainage Area.*

The September 30 / October 1 rain event occurred at the tail end of water year 2010, following a relatively dry couple of weeks, at baseflow conditions in area rivers. Figure 3 depicts instantaneous flows (USGS provisional data) in the Little Otter Creek, New Haven River, and Lewis Creek normalized to gaged drainage area for this event. Daily mean flow and peak flow in each of these watersheds were higher during this event than at any time during the previous water year (ending September 30, 2010). As part of the flow study in the Little Otter Creek (reported separately), grab samples were collected at three stations during this flow event: LOC14.4, LOC10, and LOC7.8.

Figure 3 illustrates the differing hydrology of the ACRWC watersheds. The New Haven River is a more flashy watershed; its hydrograph in response to the Sept 30 / Oct 1 rains demonstrated a shorter time to peak, higher peak size, and quicker recession than either the Lewis Creek or Little Otter Creek. Peak flow for this event in the New Haven River (11,000 cfs on 10/1/10) represented a storm of an approximate 25-year magnitude (Olson, 2002). Roads in the watershed (e.g, Route 116 in Bristol, River Road in New Haven) were closed due to inundation flooding (NCDC, 2011). In Lewis Creek, the storm yielded a peak flow of 3,100 cfs on 10/1/10, equating to an approximate 5-year storm (Olson, 2002). In the Little Otter Creek, peak flow for this storm reached 1,000 cfs at the Route 7 USGS gage on 10/2/10; this value corresponded to an approximate bankfull event, just shy of the 1,120 cfs flow estimated for the 2-year event by Olson (2002). The hydrograph for Little Otter Creek illustrates a broader, more curved peak of lower magnitude, with a gradual recession – characteristic of lower-gradient channels with more flow attenuation.



*Figure 3. September 30 / October 1, 2010 Storm Event Sampling in the Little Otter Creek, relative to Instantaneous Flows (USGS Provisional) Normalized to Gaged Drainage Area in Regional Watersheds.*

## 6.0 Geology / Land Use

Table 5 summarizes the physical characteristics of the ACRWC watersheds and nearby LaPlatte River. A majority of the drainage area for the New Haven River and Middlebury River is positioned in the mountainous terrain of the Northern Green Mountain physiographic province. Lewis Creek also has a significant percentage of its drainage area in this province. LaPlatte River, Little Otter Creek and Lemon Fair River are located further to the west in the broad, low-relief, Champlain Valley physiographic province. Thus, topographic relief and overall gradients of the New Haven River, Middlebury River and Lewis Creek are substantially higher than that of the Champlain Valley watersheds. Figure 4 depicts the longitudinal profiles of these rivers.

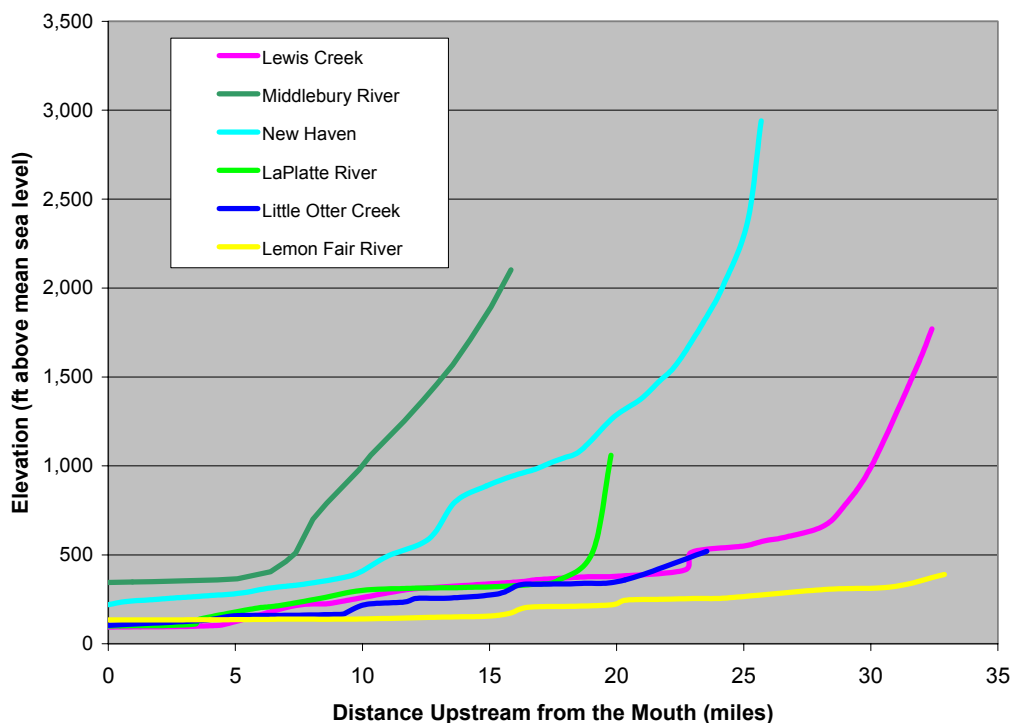
As illustrated by the hydrographs from the September 30 / October 1, 2010 storm (Figure 3), the Green Mountain watersheds (New Haven River, Middlebury River, and Lewis Creek; shaded yellow in Table 5) tend to exhibit flashier flows, than the Champlain Valley watersheds due, in part, to the steeper overall gradients. The lower-gradient watersheds of the Champlain Valley (shaded blue in Table 5) tend to be characterized by higher percentages of hydric soils derived from lacustrine and marine lake sediments, and have higher percentages of wetlands which offer temporary surface water storage and lagged flows, resulting in broader, lower-magnitude storm peaks, longer times to peak, and gradual hydrograph recessions.

Table 4. Physical Features of ACRWC watersheds.

Watershed	Physical Characteristics										
	Geologic Province (1 )		Soils (2)	% Hydric	% Wetlands	Topography		Major Land Cover/			Stream
	NGM	CV	(% Lake Sediments)	Soils	(VSWI)	Relief (ft)	Gradient (ft / mile)	Land Use			Classification (Class B) (3)
	Forest	Agric	Urban								
Middlebury River 63 sq mi	71%	29%	10%	15.2%	3.2%	1,758	111	81%	11%	3%	Cold Water Fish
New Haven River 116 sq mi	63%	37%	14%	9.8%	2.5%	2,720	106	76%	15%	4%	Cold Water Fish
Lewis Creek 81 sq mi	31%	69%	24%	18.6%	6.5%	1,676	52	60%	26%	5%	Cold Water Fish
LaPlatte River 53 sq mi	5%	95%	45%	25.3%	6.1%	960	49	38%	39%	16%	Warm Water Fish
Little Otter Creek 73 sq mi	--	100%	62%	30.3%	9.7%	416	18	35%	45%	4%	Cold Water Fish
Lemon Fair River 91 sq mi	--	91%	63%	19.3%	7.3%	256	8	25%	63%	6%	Warm Water Fish
Lower Otter Creek 498 sq mi (of 944 sq mi basin)	29%	69%	38%	20.8%	8.9%	NM	NM	67%	21%	6%	Warm Water Fish

**Notes:**

- (1) NGM = Northern Green Mountains; CV = Champlain Valley; geologic province after Stewart & MacClintock (1969) or biophysical province after the VT Biodiversity Project.
- (2) Soils of glaciolacustrine parent material, Natural Resource Conservation Service County Soil Survey Data.
- (3) As per VT Water Quality Standards, effective Jan 1, 2008.



*Figure 4. Longitudinal Profile of ACRWC Rivers and LaPlatte River.*

In general, the Green Mountain watersheds tend to have higher percentages of forest cover, while the Champlain Valley watersheds have higher percentages of agricultural land use.

## 7.0 Sample Results

Appendix B contains quality-assured sample results for the 2010 season for the ACRWC watersheds. Attachments 1 through 6 summarize these results on a single page for each watershed. These attachments have been designed to serve as a handout for use in future outreach events to watershed stakeholders and relevant town boards.

As discussed in Section 2.0, the Little Otter Creek and New Haven River were chosen as focus watersheds for the 2010 season (and 2011 season). Therefore, sample results are presented for sentinel as well as rotational sites in these watersheds. A more detailed report of the flow study in the Little Otter Creek is presented under separate cover.

## 8.0 References

Olson, Scott A., 2002, Flow-Frequency Characteristics of Vermont Streams. USGS Water-Resources Investigations Report 02-4238.

National Climatic Data Center, 2011, Event Narrative for Flash Flood, 1 October 2010, Addison County, Vermont, accessed on 09 February 2011 at: <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~storms>

NOAA Online Weather Data: Daily Almanac accessed at:  
<http://www.weather.gov/climate/xmacis.php?wfo=btv>

USGS, 2011, on-line surface water data, <<http://waterdata.usgs.gov/vt/nwis>>.



**Appendix A**  
**Addison County Riverwatch Collaborative**  
**Summary Report: 2010 Sampling Results**

**Quality Assurance / Quality Control Summary Report**

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## **I. Introduction**

This appendix provides a summary of the Quality Assurance review of sampling results for the 2010 season in six watersheds monitored by the Addison County River Watch Collaborative:

- Lemon Fair River
- Lewis Creek
- Little Otter Creek (including Mud Creek)
- Middlebury River
- New Haven River
- Otter Creek

The Addison County River Watch Collaborative sampled 20 sites in these six watersheds during two Spring events (April and May) and four Summer events (June, July, August and September).

- April 6/7
- May 4/5
- June 2
- July 7
- August 4
- September 1

At the request of VTDEC and LaRosa Laboratory, the number of sampling sites and parameters was reduced beginning with the June event. Therefore, a different schedule of sampling sites and parameters was developed for Spring months (April, May) versus the Summer months (June, July, August, September) (see Table 1a).

A flow study was undertaken in 2010 in the Little Otter Creek watershed and will continue into 2011. This flow study was designed to rely on Spring and Summer sampling results from the ACRWC program for select stations, as well as separate samplings of storm events which occur outside the regular ACRWC monitoring schedule. One such event was monitored between Sept 29 and Oct 4 of 2010. Four grab samples were collected at each of three stations during this event to monitor changes in concentrations of TP, DP, and Turbidity throughout the storm hydrograph. A 2010 schedule of sampling sites and parameters for the flow study is presented in Table 1b.

*Table 1a. 2010 Schedule of Sites / Parameters – Spring and Summer*

Project Name: Addison County River Watch Collaborative

Project Number: **137-01**

Sample Year: <b>2010</b>				Spring Schedule (Apr, May)							Summer Schedule (Jun, Jul, Aug, Sep)						
Type	River Name	Site ID	Site Location	PARAMETERS							PARAMETERS						
				<i>E.coli</i>	TP	DP	TN	NOx	Turbidity	TSS	<i>E.coli</i>	TP	DP	TN	NOx	Turbidity	TSS
S	Lewis Creek	LCR3.7	Old Route 7 Bridge		X				X		X	X				X	
S	Lewis Creek	LCR14	Tyler Bridge		X				X		X	X				X	
S	Lemon Fair River	LFR6.7	Route 125 bridge. (temporarily replaced by LFB2.5 during bridge construction)		X		X		X		X	X		X		X	
temp	Lemon Fair River	LFB2.5	Beaver Branch, a trib up from Rt 125 bridge														
S	Lemon Fair River	LFR12	Downstream of Route 74 bridge		X		X		X		X	X		X		X	
R	Little Otter Creek	LOC14.4	Plank Rd.		X	X	X		X	X	X	X	X	X		X	X
R	Little Otter Creek	LOC10	Monkton Road		X	X	X		X	X	X	X	X	X		X	X
R	Little Otter Creek	LOC8	Wing Rd bridge		X	X	X		X	X	X	X	X	X		X	X
R	Little Otter Creek	LOC7.8	Middlebrook Rd (North)		X	X	X		X	X	X	X	X	X		X	X
S	Little Otter Creek	LOC4.3	Route 7 Bridge		X	X	X		X	X	X	X	X	X		X	X
S	Mud Creek	MDC1.2	Wing Rd./Middlebrook Rd. (South)		X	X	X		X	X	X	X	X	X		X	X
S	Middlebury River	MIR1.5	Shard Villa Rd. Bridge		X				X		X	X				X	
S	Middlebury River	MIR5.7	Midd. Gorge @ Rte 125 Bridge		X				X		X	X				X	
R	New Haven River	NHR.5	Dog Team Tavern		X				X		X	X				X	
S	New Haven River	NHR2	Mud Creek confluence		X				X		X	X				X	
R	New Haven River	NHR11.5	Bartlett's Falls Pool		X				X			X				X	
R	New Haven River	NHR15	S. Lincoln Bridge (Gap Rd.)		X				X			X				X	
R	New Haven River	NHR6	Route 116 Bridge, Sycamore Park		X				X		X	X				X	
S	New Haven River	NHR9	South St. Bridge		X				X			X				X	
S	Otter Creek	OTR21	Belden Falls		X		X		X		X	X		X		X	
S	Otter Creek	OTR7.3	Vergennes Falls/below outfall		X		X		X		X	X		X		X	

Site Types: R = Rotational; S = Sentinel

ACRWC 2010 sampling dates were: Spring: April 6/7, May 4/5; Summer: June 2, July 7, August 4, September 1

No *E.coli* samples were collected during Spring events (April, May), only during Summer events (June, July, Aug, Sept)

*Table 1b. 2010 Schedule of Sites / Parameters – Flow Study*

Project Name: Addison County River Watch Collaborative

Project Number: **137-01**

Sample Year: <b>2010</b>				Flow Study						
Type	River Name	Site ID	Site Location	PARAMETERS						
				<i>E.coli</i>	TP	DP	TN	NOx	Turbidity	TSS
S	Lewis Creek	LCR3.7	Old Route 7 Bridge							
S	Lewis Creek	LCR14	Tyler Bridge							
S	Lemon Fair River	LFR6.7	Route 125 bridge. (temporarily replaced by LFB2.5 during bridge construction)							
temp	Lemon Fair River	LFB2.5	Beaver Branch, a trib up from Rt 125 bridge							
S	Lemon Fair River	LFR12	Downstream of Route 74 bridge							
R	Little Otter Creek	LOC14.4	Plank Rd.		X	X			X	
R	Little Otter Creek	LOC10	Monkton Road		X	X			X	
R	Little Otter Creek	LOC8	Wing Rd bridge							
R	Little Otter Creek	LOC7.8	Middlebrook Rd (North)		X	X			X	
S	Little Otter Creek	LOC4.3	Route 7 Bridge							
S	Mud Creek	MDC1.2	Wing Rd./Middlebrook Rd. (South)							
S	Middlebury River	MIR1.5	Shard Villa Rd. Bridge							
S	Middlebury River	MIR5.7	Midd. Gorge @ Rte 125 Bridge							
R	New Haven River	NHR.5	Dog Team Tavern							
S	New Haven River	NHR2	Mud Creek confluence							
R	New Haven River	NHR11.5	Bartlett's Falls Pool							
R	New Haven River	NHR15	S. Lincoln Bridge (Gap Rd.)							
R	New Haven River	NHR6	Route 116 Bridge, Sycamore Park							
S	New Haven River	NHR9	South St. Bridge							
S	Otter Creek	OTR21	Belden Falls							
S	Otter Creek	OTR7.3	Vergennes Falls/below outfall							

Site Types: R = Rotational; S = Sentinel

ACRWC 2010 flow study sampling dates were: Sept 29, Oct 1, Oct 2, Oct 4

## II. Data Validation

The following sections discuss data quality objectives and 2010 season results with respect to Completeness, Accuracy (Field Blank results) and Precision (Field Duplicate results). Recommended corrective actions for identified issues are addressed in Section IV.

### II.A Completeness

#### *Completeness – Primary Samples*

ACRWC goals for completeness according to the Quality Assurance Project Plan are 80%. A summary of the completeness percentages achieved in the 2010 sampling season is presented in Table 2. Details of these completeness calculations are contained in Tables 3a, 3b and 3c. As requested, a copy of completed *QAPP Table 7c* is also presented as an attachment to this Appendix, which summarizes the same information in a slightly different manner (A copy of *QAPP Table 7c* was submitted along with completed Data Submittal worksheets to LaRosa Labs on 31 January 2011). Due to the change in scheduled parameters after the May sampling event, completeness has been calculated separately for the Spring months (April, May) and the Summer months (June, July, August, September).

*Table 2. Summary of Project Completeness – 2010 Sampling Season*

Season:	Spring	Summer	Flow Study	Totals
Total # Scheduled Samples:	184	316	36	536
Actual # Samples Achieved	149	311	27	487
Percent Completeness:	81%	98%	75%	91%

Calculations of completeness take into account, not only whether the sample was achieved (successfully collected with a result reported by the lab), but also account for sample results that may have been rejected for reasons of not meeting data quality objectives (as further detailed in Sections II.B and II.C).

In the case where samples were collected for additional (unscheduled) tests, these results were not included in the calculation of completeness (e.g., DP, TP for LOC11 in April, TSS for LCR14 & LCR3.7 in April; TN for all NHR stations in June; DP & TSS for LFR stations in June; E.coli for NHR9 in August) (see Sections III.B and III.E for further details).

Percent completeness calculations presented in Table 2 and in Tables 3a, 3b, and 3c do not include the field QC samples (Field Blanks and Field Duplicates). Instead, completeness of these QC samples is addressed in Tables 4a and 4b.

Table 3.a – Completeness Calculation for Spring Sampling Events

2010 ACRWC waters					Spring Schedule - April, May						
Sample	Project	River Name	Site ID	Site Location	PARAMETERS						
					E.coli	TP	DP	TN	NOx	Turbidity	TSS
2010	ACRWC	Lewis Creek	LCR3.7	Old Route 7 Bridge		X				X	
2010	ACRWC	Lewis Creek	LCR14	Tyler Bridge		X				X	
2010	ACRWC	Lemon Fair River	LFR6.7	Route 125 bridge. (temp replaced by LFB2.5 during bridge construction, Aug, Sept)		X	X	X		X	X
2010	ACRWC	Lemon Fair River	LFB2.5	Beaver Branch, a trib up from Rt 125 bridge							
2010	ACRWC	Lemon Fair River	LFR12	Downstream of Route 74 bridge		X	X	X		X	X
2010	ACRWC	Little Otter Creek	LOC14.4	Plank Rd.		X	X	X		X	X
2010	ACRWC	Little Otter Creek	LOC10	Monkton Road - (new station to replace LOC11)		X	X	X		X	X
2010	ACRWC	Little Otter Creek	LOC8	Wing Rd bridge		X	X	X		X	X
2010	ACRWC	Little Otter Creek	LOC7.8	Middlebrook Rd (North)		X	X	X		X	X
2010	ACRWC	Little Otter Creek	LOC4.3	Route 7 Bridge		X	X	X		X	X
2010	ACRWC	Mud Creek	MDC1.2	Wing Rd./Middlebrook Rd. (South)		X	X	X		X	X
2010	ACRWC	Middlebury River	MIR1.5	Shard Villa Rd. Bridge		X				X	X
2010	ACRWC	Middlebury River	MIR5.7	Midd. Gorge @ Rte 125 Bridge		X				X	X
2010	ACRWC	New Haven River	NHR.5	Dog Team Tavern		X	X	X		X	X
2010	ACRWC	New Haven River	NHR2	Mud Creek confluence		X	X	X		X	X
2010	ACRWC	New Haven River	NHR11.5	Bartlett's Falls Pool		X	X	X		X	X
2010	ACRWC	New Haven River	NHR15	S. Lincoln Bridge (Gap Rd.)		X	X	X		X	X
2010	ACRWC	New Haven River	NHR6	Route 116 Bridge, Sycamore Park		X	X	X		X	X
2010	ACRWC	New Haven River	NHR9	South St. Bridge		X	X	X		X	X
2010	ACRWC	Otter Creek	OTR21	Belden Falls		X	X	X	X	X	X
2010	ACRWC	Otter Creek	OTR7.3	Vergennes Falls/below outfall		X	X	X	X	X	X

ACRWC 2010 sampling dates are: Spring: April 7, May 5; Summer: June 2, July 7, August 4, September 1 (Wednesdays)

No E.coli samples will be collected during Spring sampling (April, May), only during four summer sample events (June, July, Aug, Sept)

Regular Collaborative Schedule (Spring 2010):

Total # stations per event	0	20	16	16	2	20	18	Totals
Total # of events	2	2	2	2	2	2	2	
Total # samples per year	0	40	32	32	4	40	36	184
Actual # samples per year		31	23	24	2	36	33	149
Percent Completeness:	N/A	78%	72%	75%	50%	90%	92%	81%
Total Missing:		9	9	8	2	4	3	35
Missing: not collected, or not processed		3	7	8	2	4	3	
Rejected due to QC issues:		6	2					



*Table 3.b – Completeness Calculation for Summer Sampling Events*

2010 ACRWC waters					Summer Schedule - June, July, Aug, Sept						
Sample	Project	River Name	Site ID	Site Location	PARAMETERS						
					E.coli	TP	DP	TN	NOx	Turbidity	TSS
2010	ACRWC	Lewis Creek	LCR3.7	Old Route 7 Bridge	X	X				X	
2010	ACRWC	Lewis Creek	LCR14	Tyler Bridge	X	X				X	
2010	ACRWC	Lemon Fair River	LFR6.7	Route 125 bridge. (temp replaced by LFB2.5 during bridge construction, Aug, Sept)	X	X		X		X	
2010	ACRWC	Lemon Fair River	LFB2.5	Beaver Branch, a trib up from Rt 125 bridge							
2010	ACRWC	Lemon Fair River	LFR12	Downstream of Route 74 bridge	X	X		X		X	
2010	ACRWC	Little Otter Creek	LOC14.4	Plank Rd.	X	X	X	X		X	X
2010	ACRWC	Little Otter Creek	LOC10	Monkton Road - (new station to replace LOC11)	X	X	X	X		X	X
2010	ACRWC	Little Otter Creek	LOC8	Wing Rd bridge	X	X	X	X		X	X
2010	ACRWC	Little Otter Creek	LOC7.8	Middlebrook Rd (North)	X	X	X	X		X	X
2010	ACRWC	Little Otter Creek	LOC4.3	Route 7 Bridge	X	X	X	X		X	X
2010	ACRWC	Mud Creek	MDC1.2	Wing Rd./Middlebrook Rd. (South)	X	X	X	X		X	X
2010	ACRWC	Middlebury River	MIR1.5	Shard Villa Rd. Bridge	X	X				X	
2010	ACRWC	Middlebury River	MIR5.7	Midd. Gorge @ Rte 125 Bridge	X	X				X	
2010	ACRWC	New Haven River	NHR.5	Dog Team Tavern	X	X				X	
2010	ACRWC	New Haven River	NHR2	Mud Creek confluence	X	X				X	
2010	ACRWC	New Haven River	NHR11.5	Bartlett's Falls Pool		X				X	
2010	ACRWC	New Haven River	NHR15	S. Lincoln Bridge (Gap Rd.)		X				X	
2010	ACRWC	New Haven River	NHR6	Route 116 Bridge, Sycamore Park	X	X				X	
2010	ACRWC	New Haven River	NHR9	South St. Bridge		X				X	
2010	ACRWC	Otter Creek	OTR21	Belden Falls	X	X		X		X	
2010	ACRWC	Otter Creek	OTR7.3	Vergennes Falls/below outfall	X	X		X		X	

ACRWC proposed 2010 sampling dates are: Spring: April 7, May 5; Summer: June 2, July 7, August 4, September 1 (Wednesdays)

No E.coli samples will be collected during Spring sampling (April, May), only during four summer sample events (June, July, Aug, Sept)

Regular Collaborative Schedule (Summer 2010):

Total # stations per event	17	20	6	10		20	6	Totals
Total # of events	4	4	4	4		4	4	
Total # samples per year	68	80	24	40		80	24	316
Actual # samples per year	67	80	20	40		80	24	311
Percent Completeness:	99%	100%	83%	100%	N/A	100%	100%	98%
Total Missing:	1	0	4	0		0	0	5
Missing: not collected, or not processed	1	0	4	0		0	0	
Rejected due to QC issues:								

Table 3.c – Completeness Calculation for Flow Study Sampling Events

2010 ACRWC waters					Flow Study Schedule - Storm: 9/29, 10/1, 10/2, 10/4						
Sample	Project	River Name	Site ID	Site Location	PARAMETERS						
					E.coli	TP	DP	TN	NOx	Turbidity	TSS
2010	ACRWC	Lewis Creek	LCR3.7	Old Route 7 Bridge							
2010	ACRWC	Lewis Creek	LCR14	Tyler Bridge							
2010	ACRWC	Lemon Fair River	LFR6.7	Route 125 bridge. (temp replaced by LFB2.5 during bridge construction, Aug, Sept)							
2010	ACRWC	Lemon Fair River	LFB2.5	Beaver Branch, a trib up from Rt 125 bridge							
2010	ACRWC	Lemon Fair River	LFR12	Downstream of Route 74 bridge							
2010	ACRWC	Little Otter Creek	LOC14.4	Plank Rd.		X	X			X	
2010	ACRWC	Little Otter Creek	LOC10	Monkton Road - (new station to replace LOC11)		X	X			X	
2010	ACRWC	Little Otter Creek	LOC8	Wing Rd bridge							
2010	ACRWC	Little Otter Creek	LOC7.8	Middlebrook Rd (North)		X	X			X	
2010	ACRWC	Little Otter Creek	LOC4.3	Route 7 Bridge							
2010	ACRWC	Mud Creek	MDC1.2	Wing Rd./Middlebrook Rd. (South)							
2010	ACRWC	Middlebury River	MIR1.5	Shard Villa Rd. Bridge							
2010	ACRWC	Middlebury River	MIR5.7	Midd. Gorge @ Rte 125 Bridge							
2010	ACRWC	New Haven River	NHR.5	Dog Team Tavern							
2010	ACRWC	New Haven River	NHR2	Mud Creek confluence							
2010	ACRWC	New Haven River	NHR11.5	Bartlett's Falls Pool							
2010	ACRWC	New Haven River	NHR15	S. Lincoln Bridge (Gap Rd.)							
2010	ACRWC	New Haven River	NHR6	Route 116 Bridge, Sycamore Park							
2010	ACRWC	New Haven River	NHR9	South St. Bridge							
2010	ACRWC	Otter Creek	OTR21	Belden Falls							
2010	ACRWC	Otter Creek	OTR7.3	Vergennes Falls/below outfall							

ACRWC is conducting additional sampling in the Little Otter Creek in conjunction with a flow / loading study in 2010-2011. In addition to the regularly-scheduled Spring & Summer events, specific flow events were targeted for additional sampling at 3 LOC stations.

Flow Study Schedule (2010):								
Total # stations per event	0	3	3	0	0	3	0	
Total # of events		4	4	4	4	4	4	Totals
Total # samples per year	0	12	12	0	0	12	0	36
Actual # samples per year		12	12	0	0	3	0	27
Percent Completeness:	N/A	100%	100%	N/A	N/A	25%	N/A	75%
Total Missing:		0	0			9		9
Missing: not processed		0	0			9		
Rejected due to QC issues:								

Could not submit Turbidity samples from 9/29, 10/1, & 10/2 because storm occurred on a weekend and LaRosa Lab was not open to process samples within the 48-hr holding time.

Reasons for missing samples – either not collected, or not processed – included, but are not necessarily limited to the following:

- Scheduled samples not collected due to mis-communications between ACRWC and LaRosa on the PRELOG request (primarily in the Spring), resulting in no sample labels being delivered (April, May). Insufficient checks during bottle labeling and prep for sampling to identify missing or incorrect labels. PRELOG label errors / omissions exacerbated by confusion from mid-season reductions in site numbers and scheduled parameters (due to VTDEC budget constraints).
- Select delivered samples not processed at the LaRosa Labs. Reasons for the lab not processing samples were not articulated, but based on past experience and limited communication of lab personnel with Ethan Swift, reasons may have included samples arriving at the lab with insufficient sample volume, samples having insufficient volume following lab filtration (DP), sample vials with leaking caps (TN), samples arriving with out-of-spec temperatures.
- Some samples were submitted to the lab, but for unknown reasons results were not reported by the lab (DP for select LOC stations in August).
- While Turbidity samples were collected during each of the four sampling dates that comprised the October 1 storm event (Flow Study in the Little Otter Creek), Turbidity samples for three out of the four dates were not submitted to the lab, because the storm occurred over a weekend. LaRosa Laboratory was not open on the weekend to process the samples within the 48-hour holding time.

### ***Completeness - Field QC Samples***

The ACRWC QAPP specifies collection of Field Duplicates and Field Blanks at a frequency of 1 / 10 primary samples for each scheduled analyte, per event. Tables 4a and 4b summarize the completeness goals for Field Duplicates and Field Blanks during the 2010 season. Frequencies that did not meet the desired 10% goal are highlighted in red.

During the Spring events (April, May), Field Blank and Field Duplicate samples were collected and processed at a 10% frequency or greater except for two cases:

- For reasons unclear at this time, no Field Blank or Duplicates were collected for NO<sub>x</sub> analysis at two scheduled sites during either event: OTR21 and OTR7.3 (originally labeled OTRVE).
- One of the two scheduled and collected Field Blank samples for TSS in April was not processed at the lab (for unspecified reasons) – site OTR7.3 (originally labeled OTRVE).

Table 4a. Completeness Goals for Frequency of Field Blank Samples

### Field Blanks

Spring Schedule - April, May						
PARAMETERS						
<i>E.coli</i>	TP	DP	TN	NOx	Turbidity	TSS
Apr 6 / 7	3 / 17	1 / 10	2 / 9	0 / 2	4 / 17	1 / 17
May 4 / 5	4 / 20	2 / 16	3 / 16	0 / 2	4 / 20	4 / 18

Summer Schedule - June, July, Aug, Sept						
PARAMETERS						
<i>E.coli</i>	TP	DP	TN	NOx	Turbidity	TSS
2-Jun	1 / 17	2 / 20	0 / 8	0 / 16	2 / 20	0 / 6
7-Jul	2 / 17	2 / 20	0 / 6	2 / 10	2 / 20	0 / 6
4-Aug	2 / 18	2 / 20	0 / 2	2 / 10	2 / 20	0 / 6
1-Sep	2 / 17	2 / 20	0 / 6	2 / 12	2 / 20	0 / 6

Flow Study Schedule - Storm: 9/29, 10/1, 10/2, 10/4						
PARAMETERS						
<i>E.coli</i>	TP	DP	TN	NOx	Turbidity	TSS
	1 / 12	1 / 12			1 / 3	

Table 4b. Completeness Goals for Frequency of Field Duplicate Samples

### Field Duplicates

Spring Schedule - April, May						
PARAMETERS						
<i>E.coli</i>	TP	DP	TN	NOx	Turbidity	TSS
Apr 6 / 7	2 / 17	1 / 10	1 / 9	0 / 2	4 / 17	2 / 17
May 4 / 5	4 / 20	2 / 16	3 / 16	0 / 2	4 / 20	4 / 18

Summer Schedule - June, July, Aug, Sept						
PARAMETERS						
<i>E.coli</i>	TP	DP	TN	NOx	Turbidity	TSS
2-Jun	1 / 17	0 / 8	0 / 16		2 / 20	0 / 8
7-Jul	2 / 17	0 / 6	2 / 10		2 / 20	0 / 6
4-Aug	0 / 18	0 / 2	2 / 10		2 / 20	0 / 6
1-Sep	2 / 17	0 / 6	0 / 12		2 / 20	0 / 6

Flow Study Schedule - Storm: 9/29, 10/1, 10/2, 10/4						
PARAMETERS						
<i>E.coli</i>	TP	DP	TN	NOx	Turbidity	TSS
	0 / 12	0 / 12			0 / 3	

During the Summer events (June, July, August, September), Field Blank and Field Duplicate samples were collected and processed at a frequency of 10% or greater, except for the following cases:

- No Field Blank or Duplicates were collected for DP or TSS analysis to cover six scheduled and sampled sites during any of the Summer events (Little Otter Creek). Apparently, QC samples were not specified on the Pre-Log request. A check of the provided sample labels versus the scheduled QC sample frequency specified in the QAPP did not occur prior to sampling.
- No Field Duplicates were achieved for E.coli analysis to cover eighteen sampled sites during the August event (all scheduled 2010 sites in six watersheds). Field duplicates were scheduled on the PRELOG for LFR12 and LFR6.7 (for which LFB2.5 was later substituted due to bridge construction). It is possible that labels were not supplied. It is also possible that samples were collected and delivered but were not processed and/or not reported by the lab. A specific check of the provided sample labels versus the PRELOG did not occur prior to sampling.
- No Field Duplicates were achieved for TN analysis to cover sixteen sampled sites in June or 12 sampled sites in September (multiple watersheds). A field duplicate was scheduled on the PRELOG for LCR3.7. It is possible that labels were not supplied. It is also possible that samples were collected and delivered but were not processed and/or not reported by the lab. A specific check of the provided sample labels versus the PRELOG did not occur prior to sampling.
- No Field Blanks were achieved for TN analysis to cover sixteen sampled sites in June (multiple watersheds). It is possible that QC samples were not specified on the Pre-Log request and/or labels were not supplied. A check of the provided sample labels versus the scheduled QC sample frequency specified in the QAPP did not occur prior to sampling.

For the flow monitoring study in Little Otter Creek, a specific collection frequency for field QC samples had not been established for storm event sampling that occurred outside the regular ACRWC program. Field blanks for TP & DP were achieved at a frequency of 1 in 12 for the October storm event. Field blanks for Turbidity were achieved at a frequency of 1 in 3 for the October storm event.

- No Field Duplicates were achieved to cover twelve TP, twelve DP or three Turbidity samples collected during the October storm event. A Field Duplicate for TP, DP, and Turbidity analysis was collected in the field (a frequency of 1 per 12 for TP & DP; a frequency of 1 per 3 for Turbidity). For unknown reasons, results for the collected Field Duplicates were not reported by the lab. The sample collector personally delivered the samples to LaRosa Labs, filtered the DP (QC and regular) samples, added the unscheduled Field Blank and Field Duplicates for this event to the Pre-Log sheet, and worked with the Lab Director to generate labels for these QC samples.

## II.B Field Blank results

Field Blank results are summarized in Table 5.

### Total Nitrogen

In April, Total Nitrogen (TN) was reported by the lab as having been detected in a Field Blank sample collected for the Lemon Fair (LFR12BLK). The Field Blank and Primary Samples were likely reversed either in the field or lab. Results have been revised as indicated below.

*As Revised for Final Data Delivery to LaRosa:*

Sample Num	Location	QA	Date	Test	Sym	Results	Units
100356-04	LFR12 BLK	B	7/7/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L
100356-11	LFR12BLK	B	7/7/2010	Nitrogen, Total - Persulfate		1.32	mg/L
100356-12	LFR12DUP	D	7/7/2010	Nitrogen, Total - Persulfate		1.25	mg/L

For the remaining sampling events (May, June, July, August, and September), no TN was detected above the method detection limit (0.1 mg/L) in the field blanks.

### Total Phosphorus

In April, 11.7 ug P/L Total Phosphorus was detected in a Field Blank from Little Otter station LOC14.4. It is possible that a sample from (unscheduled site) LOC11 collected on the same date may have been switched with this Field Blank sample LOC14.4BLK since results for LOC11 were reported as non-detect (< 5 ug P/L). A non-detect result for LOC11 is unexpected, since historically this station has had detectable quantities of TP. Detectable quantities of Total Phosphorus in all seven Little Otter sites for the April event have been flagged due to this Field Blank result: “J” for estimated if the detected amount was  $\geq 5$  times the blank value, or “R” for rejected if the detected amount was < 5 times this blank value. None of the TP results for other sample sites in other ACRWC watersheds have been flagged for this event, as field blanks for TP in those other watersheds indicated acceptable results (non-detect) in April.

In May, 23.8 ug P/L Total Phosphorus (TP) was detected in a Field Blank from Lemon Fair station LFR6.7. Detectable quantities of TP in all LFR stations for the May event have been flagged due to this Field Blank result: “J” for estimated if the detected amount was  $\geq 5$  times the blank value, or “R” for rejected if the detected amount was < 5 times this blank value. None of the TP results for other sample sites in other ACRWC watersheds have been flagged for this event, as field blanks for TP in those other watersheds indicated acceptable results (non-detect) in May.

For the remaining sampling events (June, July, August, September and the October flow event), no TP was reported above the method detection limit (5 ug P/L) in the field blanks.



Table 5. Field QC Samples

Sample Number	Location	QA	Date	Test	Sym	Results	Units	Lab Remark	QA review Notes	Goal RPD	Number Duplicate Pairs	Mean RPD
<b>FIELD BLANKS</b>												
100058-35	LOC14.4BLK	B	4/7/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L					
100058-41	OTR7.3BLK	B	4/7/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L					
100237-09	LFR6.7BLK	B	5/4/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L					
100237-26	LOC7.8BLK	B	5/5/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L					
100237-28	LOC8BLK	B	5/5/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L					
100356-04	LFR12BLK	B	7/7/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L					
100356-11	LFR12BLK	B	7/7/2010	Nitrogen, Total - Persulfate	<	1.32	mg/L		Field Blank and Field Dup were possibly reversed (either in field or lab)			
100356-09	LFR6.7BLK	B	7/7/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L					
100526-26	LFB2.5 BLANK	B	8/4/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L					
100526-11	LFR12BLK	B	8/4/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L					
100693-09	NHR.5BLK	B	9/1/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L					
100693-11	NHR2BLK	B	9/1/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L					
100058-39	MIR5.7BLK	B	4/6/2010	Phosphorus - Digested	<	5	ug P/L					
100058-35	LOC14.4BLK	B	4/7/2010	Phosphorus - Digested	<	11.7	ug P/L		Added appropriate J, R flags to TP results for LOC sites in April event.			
100058-37	NHR.5BLK	B	4/7/2010	Phosphorus - Digested	<	5	ug P/L					
100058-41	OTR7.3BLK	B	4/7/2010	Phosphorus - Digested	<	5	ug P/L					
100237-09	LFR6.7BLK	B	5/4/2010	Phosphorus - Digested	<	23.8	ug P/L		Added appropriate J, R flags to TP results for LFR sites in May event.			
100237-26	LOC7.8BLK	B	5/5/2010	Phosphorus - Digested	<	5	ug P/L					
100237-28	LOC8BLK	B	5/5/2010	Phosphorus - Digested	<	5	ug P/L					
100237-11	MIR5.7BLK	B	5/5/2010	Phosphorus - Digested	<	5	ug P/L					
100321-11	LCR14BLK	B	6/2/2010	Phosphorus - Digested	<	5	ug P/L					
100321-09	LCR3.7BLK	B	6/2/2010	Phosphorus - Digested	<	5	ug P/L					
100356-11	LFR12BLK	B	7/7/2010	Phosphorus - Digested	<	5	ug P/L					
100356-09	LFR6.7BLK	B	7/7/2010	Phosphorus - Digested	<	5	ug P/L					
100526-26	LFB2.5 BLANK	B	8/4/2010	Phosphorus - Digested	<	5	ug P/L					
100526-11	LFR12BLK	B	8/4/2010	Phosphorus - Digested	<	5	ug P/L					
100693-09	NHR.5BLK	B	9/1/2010	Phosphorus - Digested	<	5	ug P/L					
100693-11	NHR2BLK	B	9/1/2010	Phosphorus - Digested	<	5	ug P/L					
100694-10	Field Blank	B	9/29/2010	Phosphorus - Digested	<	5	ug P/L					
100058-41	OTR7.3BLK	B	4/7/2010	Phosphorus - Filtered/Digested	<	5	ug P/L					
100237-09	LFR6.7BLK	B	5/4/2010	Phosphorus - Filtered/Digested	<	5	ug P/L					
100237-26	LOC7.8BLK	B	5/5/2010	Phosphorus - Filtered/Digested	<	5	ug P/L					
100237-28	LOC8BLK	B	5/5/2010	Phosphorus - Filtered/Digested	<		ug P/L	Not processed				
100694-10	Field Blank	B	9/29/2010	Phosphorus - Filtered/Digested	<	5	ug P/L					
100328-19	LCR14 BLANK	B	6/2/2010	Preliminary E. coli.	<	1	MPN/100 ml					
100356-11	LFR12BLK	B	7/7/2010	Preliminary E. coli.	<	1	MPN/100 ml					
100356-09	LFR6.7BLK	B	7/7/2010	Preliminary E. coli.	<	1	MPN/100 ml					
100526-26	LFB2.5 BLANK	B	8/4/2010	Preliminary E. coli.	<	1	MPN/100 ml					
100526-11	LFR12BLK	B	8/4/2010	Preliminary E. coli.	<	1	MPN/100 ml					
100693-09	NHR.5BLK	B	9/1/2010	Preliminary E. coli.	<	1	MPN/100 ml					
100693-11	NHR2BLK	B	9/1/2010	Preliminary E. coli.	<	1	MPN/100 ml					
100058-35	LOC14.4BLK	B	4/7/2010	Solids, Total Suspended	<	1	mg/l					
100058-41	OTR7.3BLK	B	4/7/2010	Solids, Total Suspended	<		mg/L	Not processed				
100237-09	LFR6.7BLK	B	5/4/2010	Solids, Total Suspended	<	1	mg/l					
100237-26	LOC7.8BLK	B	5/5/2010	Solids, Total Suspended	<	1	mg/l					
100237-28	LOC8BLK	B	5/5/2010	Solids, Total Suspended	<	1	mg/l					
100237-11	MIR5.7BLK	B	5/5/2010	Solids, Total Suspended	<	1	mg/l					
100058-39	MIR5.7BLK	B	4/6/2010	Turbidity	<	0.2	NTU					
100058-35	LOC14.4BLK	B	4/7/2010	Turbidity	<	0.2	NTU					
100058-37	NHR.5BLK	B	4/7/2010	Turbidity	<	0.2	NTU					
100058-41	OTR7.3BLK	B	4/7/2010	Turbidity	<	0.2	NTU					
100237-09	LFR6.7BLK	B	5/4/2010	Turbidity	<	0.2	NTU					
100237-26	LOC7.8BLK	B	5/5/2010	Turbidity	<	0.2	NTU					

Table 5. Field QC Samples

Sample Number	Location	QA	Date	Test	Sym	Results	Units	Lab Remark	QA review Notes	Goal RPD	Number Duplicate Pairs	Mean RPD
100237-28	LOC8BLK	B	5/5/2010	Turbidity	<	0.2	NTU					
100237-11	MIR5.7BLK	B	5/5/2010	Turbidity	<	0.2	NTU					
100321-11	LCR14BLK	B	6/2/2010	Turbidity	<	0.2	NTU					
100321-09	LCR3.7BLK	B	6/2/2010	Turbidity	<	0.2	NTU					
100356-11	LFR12BLK	B	7/7/2010	Turbidity	<	0.2	NTU					
100356-09	LFR6.7BLK	B	7/7/2010	Turbidity	<	0.2	NTU					
100526-26	LFB2.5 BLANK	B	8/4/2010	Turbidity	<	0.2	NTU					
100526-11	LFR12BLK	B	8/4/2010	Turbidity	<	0.2	NTU					
100693-09	NHR.5BLK	B	9/1/2010	Turbidity	<	0.2	NTU					
100693-11	NHR2BLK	B	9/1/2010	Turbidity	<	0.2	NTU					
100694-10	Field Blank	B	9/29/2010	Turbidity	<	0.2	NTU					

Table 5. Field QC Samples

Sample Number	Location	QA	Date	Test	Sym	Results	Units	Lab Remark	QA review Notes	Goal RPD	RPD	Number Duplicate Pairs	Mean RPD
<b>FIELD DUPLICATES</b>													
100058-13	LOC14.4		4/7/2010	Nitrogen, Total - Persulfate		1.18	mg/L			20%	0.0%	8	4.1%
100058-36	LOC14.4DUP	D	4/7/2010	Nitrogen, Total - Persulfate		1.18	mg/L						
100058-42	OTR7.3DUP	D	4/7/2010	Nitrogen, Total - Persulfate		0.27	mg/L		No primary sample pair				
100237-03	LFR6.7		5/4/2010	Nitrogen, Total - Persulfate		0.68	mg/L				7.6%		
100237-10	LFR6.7DUP	D	5/4/2010	Nitrogen, Total - Persulfate		0.63	mg/L						
100237-23	LOC7.8		5/5/2010	Nitrogen, Total - Persulfate		0.72	mg/L				0.0%		
100237-27	LOC7.8DUP	D	5/5/2010	Nitrogen, Total - Persulfate		0.72	mg/L						
100237-22	LOC8		5/5/2010	Nitrogen, Total - Persulfate		0.72	mg/L				1.4%		
100237-29	LOC8DUP	D	5/5/2010	Nitrogen, Total - Persulfate		0.73	mg/L						
100356-04	LFR12 BLK	B	7/7/2010	Nitrogen, Total - Persulfate	<	0.1	mg/L						
100356-11	LFR12BLK	B	7/7/2010	Nitrogen, Total - Persulfate		1.32	mg/L				5.4%		
100356-12	LFR12DUP	D	7/7/2010	Nitrogen, Total - Persulfate		1.25	mg/L						
100356-03	LFR6.7		7/7/2010	Nitrogen, Total - Persulfate		1.05	mg/L				11.7%		
100356-10	LFR6.7DUP	D	7/7/2010	Nitrogen, Total - Persulfate		1.18	mg/L						
100526-25	LFB2.5		8/4/2010	Nitrogen, Total - Persulfate		0.4	mg/L				0.0%		
100526-27	LFB2.5 DUP	D	8/4/2010	Nitrogen, Total - Persulfate		0.4	mg/L						
100526-04	LFR12		8/4/2010	Nitrogen, Total - Persulfate		0.7	mg/L				6.9%		
100526-12	LFR12DUP	D	8/4/2010	Nitrogen, Total - Persulfate		0.75	mg/L						
100693-10	NHR.5DUP	D	9/1/2010	Nitrogen, Total - Persulfate		0.37	mg/L		No primary sample pair				
100693-12	NHR2DUP	D	9/1/2010	Nitrogen, Total - Persulfate		0.38	mg/L		No primary sample pair				
100058-40	MIR5.7DUP	D	4/6/2010	Phosphorus - Digested		6.78	ug P/L		No primary sample pair	30%		15	19.4%
100058-21	NHR.5		4/7/2010	Phosphorus - Digested		24.9	ug P/L				90.3%	14	17.6%
100058-38	NHR.5DUP	D	4/7/2010	Phosphorus - Digested		9.41	ug P/L						
100058-13	LOC14.4		4/7/2010	Phosphorus - Digested		47.9	ug P/L		R flag - due to Field Blank detection		44.6%		
100058-36	LOC14.4DUP	D	4/7/2010	Phosphorus - Digested		75.4	ug P/L		J flag - due to Field Blank detection				
100058-28	OTR7.3		4/7/2010	Phosphorus - Digested		123	ug P/L				103.1%		
100058-42	OTR7.3DUP	D	4/7/2010	Phosphorus - Digested		39.3	ug P/L						
100237-03	LFR6.7		5/4/2010	Phosphorus - Digested		148	ug P/L				0.7%		
100237-10	LFR6.7DUP	D	5/4/2010	Phosphorus - Digested		149	ug P/L						
100237-23	LOC7.8		5/5/2010	Phosphorus - Digested		121	ug P/L				3.4%		
100237-27	LOC7.8DUP	D	5/5/2010	Phosphorus - Digested		117	ug P/L						
100237-22	LOC8		5/5/2010	Phosphorus - Digested		116	ug P/L				0.9%		
100237-29	LOC8DUP	D	5/5/2010	Phosphorus - Digested		115	ug P/L						
100237-06	MIR5.7		5/5/2010	Phosphorus - Digested		8.8	ug P/L				10.1%		
100237-12	MIR5.7DUP	D	5/5/2010	Phosphorus - Digested		9.74	ug P/L						
100321-02	LCR14		6/2/2010	Phosphorus - Digested		20	ug P/L				19.8%		
100321-12	LCR14DUP	D	6/2/2010	Phosphorus - Digested		16.4	ug P/L						
100321-01	LCR3.7		6/2/2010	Phosphorus - Digested		27.8	ug P/L				0.7%		
100321-10	LCR3.7DUP	D	6/2/2010	Phosphorus - Digested		28	ug P/L						
100356-04	LFR12		7/7/2010	Phosphorus - Digested		260	ug P/L				0.0%		
100356-12	LFR12DUP	D	7/7/2010	Phosphorus - Digested		260	ug P/L						
100356-03	LFR6.7		7/7/2010	Phosphorus - Digested		157	ug P/L				1.9%		
100356-10	LFR6.7DUP	D	7/7/2010	Phosphorus - Digested		154	ug P/L						
100526-25	LFB2.5		8/4/2010	Phosphorus - Digested		49.9	ug P/L				2.8%		
100526-27	LFB2.5 DUP	D	8/4/2010	Phosphorus - Digested		51.3	ug P/L						
100526-04	LFR12		8/4/2010	Phosphorus - Digested		151	ug P/L				0.7%		
100526-12	LFR12DUP	D	8/4/2010	Phosphorus - Digested		150	ug P/L						
100693-13	NHR.5		9/1/2010	Phosphorus - Digested		13.2	ug P/L				6.6%		
100693-10	NHR.5DUP	D	9/1/2010	Phosphorus - Digested		14.1	ug P/L						
100693-14	NHR2		9/1/2010	Phosphorus - Digested		31.1	ug P/L				5.3%		
100693-12	NHR2DUP	D	9/1/2010	Phosphorus - Digested		29.5	ug P/L						

Table 5. Field QC Samples

Sample Number	Location	QA	Date	Test	Sym	Results	Units	Lab Remark	QA review Notes	Goal RPD	RPD	Number Duplicate Pairs	Mean RPD
100058-28	OTR7.3		4/7/2010	Phosphorus - Filtered/Digested		38.5	ug P/L			30%	4.0%	3	4.6%
100058-42	OTR7.3DUP	D	4/7/2010	Phosphorus - Filtered/Digested		37	ug P/L						
100237-03	LFR6.7		5/4/2010	Phosphorus - Filtered/Digested		41.6	ug P/L		No Duplicate pair				
100237-23	LOC7.8		5/5/2010	Phosphorus - Filtered/Digested		46.8	ug P/L				3.9%		
100237-27	LOC7.8DUP	D	5/5/2010	Phosphorus - Filtered/Digested		45	ug P/L						
100237-22	LOC8		5/5/2010	Phosphorus - Filtered/Digested		57.2	ug P/L				5.9%		
100237-29	LOC8DUP	D	5/5/2010	Phosphorus - Filtered/Digested		53.9	ug P/L						
100328-17	LCR14		6/2/2010	Preliminary E. coli.		866	MPN/100 ml			50%	6.2%	5	
100328-18	LCR14 DUP	D	6/2/2010	Preliminary E. coli.		921	MPN/100 ml						
100356-04	LFR12		7/7/2010	Preliminary E. coli.		272	MPN/100 ml				23.7%		
100356-12	LFR12DUP	D	7/7/2010	Preliminary E. coli.		345	MPN/100 ml						
100356-03	LFR6.7		7/7/2010	Preliminary E. coli.		84	MPN/100 ml				38.5%		
100356-10	LFR6.7DUP	D	7/7/2010	Preliminary E. coli.		124	MPN/100 ml						
100526-25	LFB2.5		8/4/2010	Preliminary E. coli.		44	MPN/100 ml		No Duplicate pair				
100526-04	LFR12		8/4/2010	Preliminary E. coli.		166	MPN/100 ml		No Duplicate pair				
100693-13	NHR.5		9/1/2010	Preliminary E. coli.		153	MPN/100 ml				25.8%		
100693-10	NHR.5DUP	D	9/1/2010	Preliminary E. coli.		118	MPN/100 ml						
100693-14	NHR2		9/1/2010	Preliminary E. coli.		345	MPN/100 ml				11.3%		
100693-12	NHR2DUP	D	9/1/2010	Preliminary E. coli.		308	MPN/100 ml						
100058-13	LOC14.4		4/7/2010	Solids, Total Suspended		9.2	mg/l			15%	42.7%	6	37.2%
100058-36	LOC14.4DUP	D	4/7/2010	Solids, Total Suspended		14.2	mg/l						
100058-28	OTR7.3		4/7/2010	Solids, Total Suspended		44.4	mg/l				32.5%		
100058-42	OTR7.3DUP	D	4/7/2010	Solids, Total Suspended		32	mg/l						
100237-03	LFR6.7		5/4/2010	Solids, Total Suspended		41.7	mg/l				97.3%		
100237-10	LFR6.7DUP	D	5/4/2010	Solids, Total Suspended		14.4	mg/l						
100237-23	LOC7.8		5/5/2010	Solids, Total Suspended		19.8	mg/l				5.9%		
100237-27	LOC7.8DUP	D	5/5/2010	Solids, Total Suspended		21	mg/l						
100237-22	LOC8		5/5/2010	Solids, Total Suspended		18.8	mg/l				45.0%		
100237-29	LOC8DUP	D	5/5/2010	Solids, Total Suspended		11.9	mg/l						
100237-06	MIR5.7		5/5/2010	Solids, Total Suspended	<	1	mg/l				0.0%		
100237-12	MIR5.7DUP	D	5/5/2010	Solids, Total Suspended	<	1	mg/l						

Table 5. Field QC Samples

Sample Number	Location	QA	Date	Test	Sym	Results	Units	Lab Remark	QA review Notes	Goal RPD	RPD	Number Duplicate Pairs	Mean RPD
100058-20	MIR5.7		4/6/2010	Turbidity		0.21	NTU			15%	25.0%	16	6.7%
100058-40	MIR5.7DUP	D	4/6/2010	Turbidity		0.27	NTU						
100058-21	NHR.5		4/7/2010	Turbidity		0.8	NTU				0.0%		
100058-38	NHR.5DUP	D	4/7/2010	Turbidity		0.8	NTU						
100058-13	LOC14.4		4/7/2010	Turbidity		17	NTU				4.2%		
100058-36	LOC14.4DUP	D	4/7/2010	Turbidity		16.3	NTU						
100058-28	OTR7.3		4/7/2010	Turbidity		5.74	NTU				0.3%		
100058-42	OTR7.3DUP	D	4/7/2010	Turbidity		5.72	NTU						
100237-03	LFR6.7		5/4/2010	Turbidity		23.8	NTU				0.4%		
100237-10	LFR6.7DUP	D	5/4/2010	Turbidity		23.7	NTU						
100237-23	LOC7.8		5/5/2010	Turbidity		55	NTU	E			2.6%		
100237-27	LOC7.8DUP	D	5/5/2010	Turbidity		53.6	NTU	E					
100237-22	LOC8		5/5/2010	Turbidity		43.3	NTU	E			0.5%		
100237-29	LOC8DUP	D	5/5/2010	Turbidity		43.5	NTU	E					
100237-06	MIR5.7		5/5/2010	Turbidity		0.47	NTU				41.0%		
100237-12	MIR5.7DUP	D	5/5/2010	Turbidity		0.31	NTU						
100321-02	LCR14		6/2/2010	Turbidity		1.47	NTU				2.1%		
100321-12	LCR14DUP	D	6/2/2010	Turbidity		1.44	NTU						
100321-01	LCR3.7		6/2/2010	Turbidity		2.76	NTU				2.5%		
100321-10	LCR3.7DUP	D	6/2/2010	Turbidity		2.83	NTU						
100356-04	LFR12		7/7/2010	Turbidity		145	NTU				0.7%		
100356-12	LFR12DUP	D	7/7/2010	Turbidity		144	NTU						
100356-03	LFR6.7		7/7/2010	Turbidity		21.2	NTU				1.9%		
100356-10	LFR6.7DUP	D	7/7/2010	Turbidity		20.8	NTU						
100526-25	LFB2.5		8/4/2010	Turbidity		5.68	NTU				0.4%		
100526-27	LFB2.5 DUP	D	8/4/2010	Turbidity		5.7	NTU						
100526-04	LFR12		8/4/2010	Turbidity		85	NTU				1.2%		
100526-12	LFR12DUP	D	8/4/2010	Turbidity		86	NTU						
100693-13	NHR.5		9/1/2010	Turbidity		1.24	NTU				2.4%		
100693-10	NHR.5DUP	D	9/1/2010	Turbidity		1.21	NTU						
100693-14	NHR2		9/1/2010	Turbidity		4.7	NTU				21.7%		
100693-12	NHR2DUP	D	9/1/2010	Turbidity		3.78	NTU						

### ***Dissolved Phosphorus***

Field Blanks collected for Dissolved Phosphorus (DP) analysis in April and May were within field accuracy goals (no DP reported above the method detection limit [5 ug P/L] in the blanks).

### ***E.coli***

Field Blanks collected for E.coli analysis in June, July, August and September were within field accuracy goals (no E.coli reported above the method detection limit [1 MPN/100 mL] in the blanks).

### ***Total Suspended Solids***

Field Blanks collected for Total Suspended Solids (TSS) analysis in April & May were within field accuracy goals (no TSS reported above the method detection limit [1 mg/L] in the blanks).

### ***Turbidity***

Field Blanks collected for Turbidity analysis in April, May, June, July, August, September and the October flow event were within field accuracy goals (no Turbidity reported above the method detection limit [0.2 NTU] in the blanks).

## ***II.C Field Duplicate results***

Field Duplicate results are summarized in Table 5, including calculation of Relative Percent Difference (RPD) values. As per the QAPP, Mean Relative Percent Difference was calculated as follows:

$$\text{RPD}_{\text{field duplicate pair 1}} = \frac{\text{absolute value (sample}_1 - \text{sample}_2)}{\text{average (sample}_1 \text{ and sample}_2)}$$

and,

$$\text{Mean RPD for "n" duplicate pairs} = \text{average (RPD}_{\text{pair 1}} + \text{RPD}_{\text{pair 2}} + \dots + \text{RPD}_{\text{pair n}})$$

Mean RPD values were within the precision goals specified for the project for all analytes, except TSS. *Note: for the April event, if the primary sample and Field Blank sample results are reversed (as discussed above), this results in an acceptable RPD value (of 5%) for station LFR12 in the Lemon Fair.*

### ***Total Suspended Solids***

The measured mean RPD for Total Suspended Solids (TSS) for the 2010 season was 37% for 6 duplicate pairs sampled during the April and May events. These duplicate pairs were collected in Little Otter Creek and Otter Creek during April, and in Little Otter Creek, Lemon Fair and Middlebury River in May. This value of 37% exceeded the stated goal of 15% mean RPD for TSS. Therefore, TSS results for April and May were flagged “J” for estimated.

Various aspects of sampling and analysis procedures, as well as natural variability, may have contributed to these elevated RPD values:

- April was the first sampling event for the ACRWC in 18 months after a hiatus in 2009. Sampling efforts relied on veteran, trained ACRWC volunteers; however, a training refresher was not performed prior to this first Spring event. It is possible that field sampling procedures introduced variability in TSS (and TP) concentrations between primary and field duplicate samples. For example, safety considerations during moderate to higher flows may have caused samplers to collect grab samples along the shoreline (where mixing may not be optimal) rather than in the channel thalweg as recommended. Some, but not all, volunteers have pole samplers.
- It is interesting to note that RPD values for *Turbidity* for duplicate pairs collected by the same ACRWC samplers at the same sites and on the same dates in question were well within target RPD ranges (< 15%), ranging from 0.3% to 4.2% RPD, except for one May duplicate pair at MIR5.7 where the calculated RPD (41%) resulted from detected amounts of Turbidity (0.47 and 0.31 NTU) that were at or just barely above the detection limit (0.2 NTU). Based on previous years' sampling results, Turbidity was poorly correlated to TSS in the Otter Creek and Lemon Fair, and only moderately well correlated in Little Otter (ACRWC, 2009, draft water quality reports). It should be noted, however, that regressions were performed on data collected during Summer events, generally, not including Spring events. The relationship of Turbidity to TSS may vary in Spring versus Summer seasons, related in part to variations in flow conditions.
- The April and May events took place during moderate flow conditions in the ACRWC watersheds (also reflecting a degree of snow melt from the headwaters in April), where natural variability in TSS (and phosphorus concentrations) might be expected to be greater than during baseflow conditions (which were representative of the June, July, August and September sampling events).

### ***Total Phosphorus***

While Mean RPD values for Total Phosphorus (19%) were within the precision goal (30%) for this analysis when calculated across the full season (15 duplicate pairs across 6 Spring and Summer events), it should be noted that RPD values for 3 duplicate pairs submitted in April were well out of the expected range (90%, 45% and 103%). These duplicate pairs were collected in Little Otter (LOC14.4), New Haven River (NHR.5), and Otter Creek (OTR7.3), respectively. Again, field sampling procedures may have introduced variability in the duplicate pair results. Moderate flow conditions may also have introduced natural variability of TP concentrations.

### III. Other QA/QC Issues

The following sections summarize other QA/QC issues encountered during the 2010 sampling season. Recommended corrective actions for these issues are addressed in Section IV.

#### *III A. Reported DP Concentrations Exceeded TP Concentrations*

For the April event, seven samples have reported Dissolved Phosphorus (DP) concentrations that are higher than the reported Total Phosphorus (TP) concentration for the same sampling site. This finding suggests human error either in the field or in the lab, or both. The seven samples were collected in the Lemon Fair and Little Otter Creek watersheds. TP and DP results for these seven sample stations in April are therefore suspect and have been flagged. For 2 of the 7 sites, the DP exceedence amount was greater than the PQL (5 ug/L); these TP & DP results were flagged “R” for rejected (and had already been flagged R or J for the field blank detection issue (Section II.B)). For the other 5 of the 7 sites, the DP exceedence amount was less than the PQL (5 ug/L); these TP & DP results were flagged “J” for estimated for this QAQC issue. However, two of these 5 were already flagged “R” for rejected due to the field blank detection issue (Section II.B).

Sample Number	Location	Date	TP	TDP	PP
100058-10	LFR12	4/6/2010	73.4	77.4	(4.0)
100058-12	LFR6.7	4/6/2010	104	82.9	21.1
100058-15	LOC10	4/7/2010	50.8	51.1	(0.3)
100058-14	LOC11	4/7/2010	< 5	47.8	
100058-13	LOC14.4	4/7/2010	47.9	49.5	(1.6)
100058-35	LOC14.4BLK	4/7/2010	11.7		
100058-36	LOC14.4DUP	4/7/2010	75.4		
100058-16	LOC4.3	4/7/2010	69.4	72.9	(3.5)
100058-17	LOC7.8	4/7/2010	77.3	91.9	(14.6)
100058-43	LOC8	4/7/2010	50.7	96.5	(45.8)
100058-18	MDC1.2	4/7/2010	80.2	82.6	(2.4)
100058-37	NHR.5BLK	4/7/2010	< 5		
100058-38	NHR.5DUP	4/7/2010	9.41		
100058-25	OTR21	4/7/2010	41.8		
100058-28	OTR7.3	4/7/2010	123	38.5	84.5
100058-41	OTR7.3BLK	4/7/2010	< 5	< 5	
100058-42	OTR7.3DUP	4/7/2010	39.3	37	2.3

It is possible that conditions in the field could vary between the collection of the TP and DP vials – either due to natural variability (e.g., flow-related), or due to sampling error (e.g., sediments disturbed during collection). This may have resulted in a DP vial that contained sufficiently higher total phosphorus than the TP vial, such that the concentration of the dissolved fraction of phosphorus in the DP vial (after lab filtering) was higher than the total phosphorus concentration in the TP vial from the same sample site. The unusually high RPD values for TP in the field duplicate pairs for the April event suggest significant natural and/or introduced variability (see Section II.C). Detection of TP in a Field Blank from the Little Otter site LOC14.4 in April (see Section II.B) also suggests either the introduction of field contamination or sample handling (labeling issues) that introduced error. There is also the potential for human error in the lab, given the filtering procedures for the DP samples.

#### *III B. Change in Scheduled Sample Stations and Parameters Mid-Year*

At a 26 May 2010 meeting of the Collaborative, Ethan Swift informed the group that the number of samples would need to be further reduced for Dissolved Phosphorus and Total Suspended



Solids analysis, at the request of VTDEC due to budgetary constraints. The scheduled number of tests was reduced accordingly, resulting in a different schedule of sample sites and parameters for the Spring versus Summer samples. This led to confusion amongst samplers and miscommunication between ACRWC and LaRosa Laboratories. During the May and June sampling events, labels were supplied for a few analytes that had been eliminated from the schedule previously. ACRWC volunteers collected samples for these additional (unscheduled) tests. Also, several labels were delivered with typographical errors, and labels for some scheduled sites were not delivered (Section III.D.), and Field Duplicate and Blank labels were delivered / specified for unscheduled sites (i.e., no labels for the primary sample corresponding to the specified QC sample labels) (Section III.E.). The change in scheduled parameters was largely out of the control of ACRWC. Nevertheless, more robust QA/QC procedures by ACRWC would have caught many of these errors or inconsistencies prior to sample collection. Confusion at the onset of the 2010 sampling season also coincided with the loss of a ACRWC Sampling Coordinator position. Sampling tasks were accomplished by a committee of ACRWC volunteers, which meant that no one person was in charge of Quality Assurance / Quality Control.

### ***III C. Sample Dates***

Samples were collected on different dates during the Spring events (April and May). Since the Spring sample schedule did not include *E. coli* (which has a 6-hour holding time), some leeway was granted to volunteers for the timing of sample collection (up to a day and a half prior to delivery to the lab). As a consequence, watersheds were sampled a day apart (in April) and some stations within the same watershed (Otter, Little Otter) were sampled a day apart (in May).

4/6 – LFR, MIR

4/7 – LCR, LOC/MDC, OTR, NHR

5/4 – OTR21, LOC (14.4, 10, MDC1.2), LFR

5/5 – OTRVE, LOC (4.3, 7.8, 8), MID, NHR

Dr. Hoadley raised the issue that these samples may not be comparable watershed-to-watershed (April) or even site-to-site within a given watershed (Otter and Little Otter in May) due to a small rain event that occurred during each of the Spring events. This may compromise the ability to perform trend analyses with these samples.

Burlington Airport recorded precipitation (in inches) on the dates that comprised these sample events, as follows:

4/6 – 0.3

5/4 – 0.38

4/7 – 0.12

5/5 - 0

Each of the mountainous Collaborative watersheds with USGS realtime gages (Lewis, Little Otter, New Haven River) exhibited a modest rise in daily mean discharge over the two-day sampling span for each of the Spring events. Figure 1 depicts Little Otter as an example.

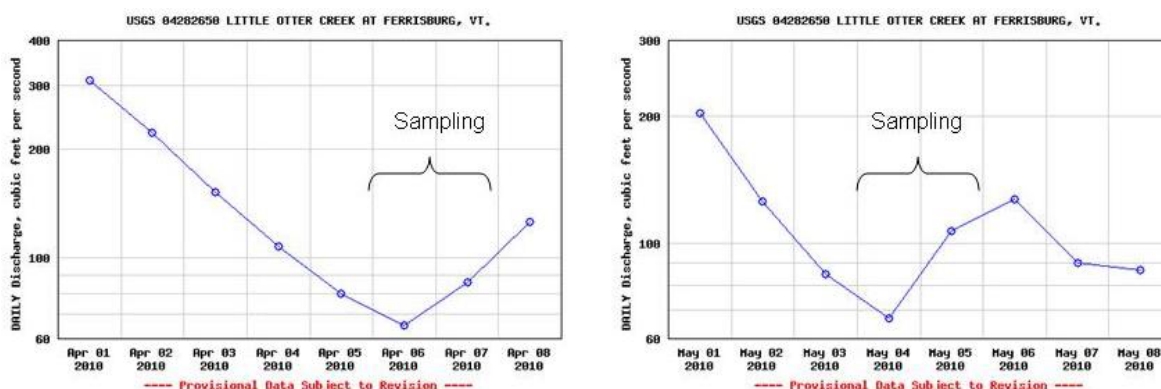


Figure 1. Daily Mean Discharge, Little Otter Creek, during Spring sampling events.

The Otter Creek (USGS gage at Middlebury) has such a large upstream drainage area and assimilative capacity that it responds more gradually and with a considerable lag time to individual storm events across the basin. Figure 2 indicates that daily mean discharge did not fluctuate significantly between April 6 and 7 or between May 4 and 5 in the Otter Creek. Therefore, it is likely that sampling of Otter sites on two separate days was less of a concern in this watershed than it may be in the more flashy watersheds.

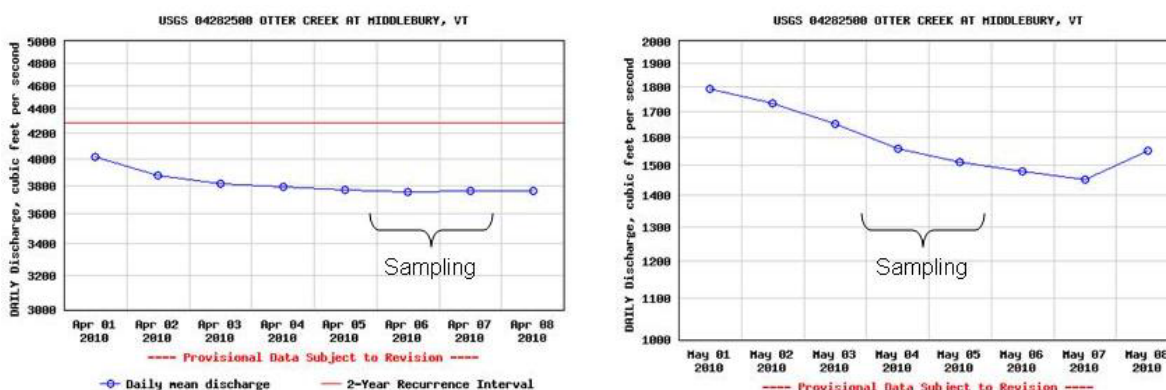


Figure 2. Daily Mean Discharge, Otter Creek at Middlebury, during Spring sampling events.

To some degree our ACRWC samples for a given event are not synoptic even when sampled on the same day; the sample collection times may range up to 5 hours apart between watersheds and within a given watershed. If a rain storm happens to occur on or immediately prior to the scheduled sample date, flows may be fluctuating considerably both within the time span of sampling, and longitudinally within a watershed. Nevertheless, representativeness can be maximized if the ACRWC strives to collect samples all on the same date in future events. By following this convention, samples will also have similar holding times before analysis, and we will minimize the potential for compromised sample preservation & custody conditions between time of sample collection and time of delivery to the lab.

### ***III D. Mis-labeled sample site identifications or sample dates***

A few sample site identifications were reported by LaRosa Laboratory with typographical errors, either due to errors on the PreLog request or transcription errors at the laboratory. These typos have been corrected in the final data submitted:

NH4.5 = NHR.5 (April)  
NHR1.5 = NHR11.5 (Sept)  
LFR3.7 = LFR6.7 (July)  
LC14.4 = LOC14.4 (August)

One sample identification was incorrectly specified by ACRWC in the original Sample Schedule and in the subsequent monthly prelogs to LaRosa Labs. Site location “OTRVE” specified on the LaRosa Labs PRELOG request (and on sample labels, and final data report from LaRosa Labs) was actually site OTR7.3. This is a new site established this season at the request of the Vergennes Town Manager to monitor E.coli upstream and downstream of sewage treatment plant. Therefore, sampling results originally reported by the lab for site “OTRVE” were revised to reflect the actual sampling site identification, “OTR7.3”. Final data delivered to VTDEC on 31 January 2011 reflect this change in site ID.

Incorrect sample dates had been entered on the sample labels for New Haven River sites in the April event. Final, QA-reviewed sample results delivered to LaRosa Laboratories on 17 February 2011 reflect the corrected date for these samples.

### ***III E. Field QC sample labels supplied for sites that were not scheduled***

For the September event, TN analysis, labels were provided for Field Blank and Field Duplicate analysis at two stations that were not scheduled for collection of a TN primary sample. As a consequence, the Duplicate result had no primary sample pair and could not be used for calculation of RPD. These were the only 2 stations among 12 sampled that were identified for a Field Duplicate, so ACRWC did not meet the 10% frequency of Field Duplicates for TN for this August event. ACRWC did not catch this in the bottle prep/ labeling stage or in the field.

## **IV. Corrective Actions**

The following corrective actions are recommended to address the above issues.

- A. The QAPP with its finalized list of sample sites and parameters for the 2011 season will be submitted for VTDEC approval in February 2011, in advance of the first sampling event (anticipated Flow Study event in late February or March (i.e., ice out), first Spring sample event April 6). The 2011 QAPP will specify updated roles for project personnel and will include additional QC checks as noted below.
- B. ACRWC will reinstitute annual refresher training that is mandatory for all volunteer samplers. There will be a requirement that new volunteers must go through full training and shadow an experienced volunteer for at least two events prior to sampling solo. Training should particularly focus on field collection methods for duplicate samples.

- C. If moderate to high-stage water events are preventing samplers from collecting samples in optimal locations (mid stream), the Collaborative should invest in more pole samplers to better enable collection of field duplicates and to ensure representativeness.
- D. Prior to each sampling event, the ACRWC QA Coordinator will check the LaRosa Labs PRELOG request against the Sampling Schedule of sites and parameters, for completeness and to ensure that Field Duplicates and Field Blanks are specified for collection at a site(s) that is scheduled for the given event, and that they are each specified for a minimum frequency of 1 per 10 primary samples.
- E. Where budgetary constraints permit, Field Duplicates and Field Blanks should be requested on the LaRosa Labs PRELOG at a higher than minimum frequency, so that if one or more QC samples are not achieved due to an issue in the field and/or lab, the minimum frequency of QC sample collection can still be met for the event.
- F. Prior to each sampling event, ACRWC will undertake a check of the lab-supplied sample bottles and labels against the LaRosa Labs PRELOG request and the ACRWC Sampling Schedule of sites and parameters, for completeness. This check will:
  - a. ensure that all labels and bottles are accounted for and correctly specified to meet the scheduled sites and parameters for the given event;
  - b. ensure that there are no typographical errors of the site identifications on the provided labels;
  - c. ensure that Field duplicates and Field Blanks are specified for collection at a scheduled site(s) for the given event, and that they are each specified for a minimum frequency of 1 per 10 primary samples;
  - d. ensure that sufficient volume of deionized water for collection of scheduled field blanks has been supplied by LaRosa Labs.
  - e. avoid the collection & analysis of unscheduled (unnecessary) samples, conserving LaRosa Lab resources.
  - f. utilize a standardized data sheet; completed checklists will be retained and available for review throughout the season and at the end of the season to interpret potential omissions of data, or other QC issues that arise in the review of laboratory results.
  - g. be performed by one person, the Project QA Coordinator (or Project Field/Sampling Leader, in their absence).
- G. ACRWC volunteer samplers will coordinate such that all samples are collected on the same day for a given event – as close as possible with respect to time.
- H. During each event, following sample collection, and prior to sample delivery to the lab, ACRWC will conduct a Sample Delivery check. This check will:
  - a. ensure that all scheduled sites and parameters (including Field Blanks and Field Duplicates) were collected as scheduled;
  - b. ensure that no sample times are omitted on sample bottles, and that they match the sample times recorded on the LaRosa Lab PRELOG sheet;

- c. utilize a standardized data sheet; completed checklists will be retained and available for review throughout the season and at the end of the season to interpret potential omissions of data, or other QC issues that arise in the review of laboratory results.
  - d. be performed by one person, the Project QA Coordinator (or Project Field/Sampling Leader, in their absence).
- I. ACRWC Project QA Coordinator will contact LaRosa Lab staff within one week of the sample event to obtain a copy of the final LaRosa Lab LOGIN (developed from the PRELOG) and check this against the ACRWC Sample Delivery Check to ensure that all delivered samples were logged in for processing. Missing samples will be resolved, where possible. The reason(s) delivered samples could not be logged in will be reviewed with LaRosa Lab personnel, and appropriate corrective action will be taken through updated training during bottle prep / labeling sessions prior to the next scheduled sample event.
- J. ACRWC Project QA Coordinator will perform a review of preliminary sample results soon after they are posted on the VTDEC web site to determine that all delivered samples were analyzed as scheduled. If there are missing samples and/or samples that were not processed for some reason, these incidents will be resolved where possible. Appropriate corrective action will be taken through updated training during bottle prep / labeling sessions prior to the next scheduled sample event.

Attachment 1.

**QAPP Table 7c – Project Completeness**

<b>Parameter</b>	<b>Number of Samples Anticipated</b>	<b>Number of Valid Samples Collected &amp; Analyzed</b>	<b>Percent Complete *</b>
Chlorophyll-a			
Total and Dissolved Phosphorus			
Total:	Spring: 40 regular	Spring: 31 regular	Spring: 78%
Dissolved:	Spring: 32 regular	Spring: 23 regular	Diss: 72%
Total:	Summer: 80 regular	Summer: 80 regular	Summer: 100%
Dissolved:	Summer: 24 regular	Summer: 20 regular	Diss: 83%
<i>E. coli</i>	Summer only: 68 regular	Summer only: 67 regular	Summer only: 99%
Total Suspended Solids	Spring: 36 regular Summer: 24 regular	Spring: 33 regular Summer: 24 regular	Spring: 92% Summer: 100%
Transparency			
Alkalinity			
pH			
Turbidity	Spring: 40 regular Summer: 80 regular	Spring: 36 regular Summer: 80 regular	Spring: 90% Summer: 100%
Total nitrogen (persulfate digestion)	Spring: 32 regular Summer: 40 regular	Spring: 24 regular Summer: 40 regular	Spring: 75% Summer: 100%
Total NOx	Spring: 4 regular	Spring: 2 regular	Spring: 50%
Si, dissolved			
Dissolved Oxygen			
Conductivity			
Temperature	120 readings	120 readings	100%

\* Percent Complete = (# of Valid Samples Collected and Analyzed) / ( # of Samples Anticipated ) \* 100

See Tables 4a and 4b in QA Summary report for summary of QC Sample Completeness.

## Lemon Fair River

Location	Date	(mpn/100ml) E. Coli.	(mg-N/l) TN	(ug P/L) TP	(ug P/L) DP	(mg/L) TSS	(NTU) Turbidity
LFR12	4/6/2010		0.52	73.4 J	77.4 J	17.2 J	38.7
LFR6.7	4/6/2010		0.59	104	82.9	9.4 J	27.8
LFR12	5/4/2010		0.62	ND R	30	13.8 J	29.3
LFR6.7	5/4/2010		0.68	148 J	41.6	41.7 J	23.8
LFR12	6/2/2010	291	0.61	161	45.8	80 J	108
LFR6.7	6/2/2010	326	0.9	199	52.3	50 J	109
LFR12	7/7/2010	272	1.32	260			145
LFR3.7	7/7/2010	84	1.05	157			21.2
LFR12	8/4/2010	166	0.7	151			85
LFB2.5	8/4/2010	44	0.4	49.9			5.68
LFR12	9/1/2010	172	0.84	184			71.6
LFB2.5	9/1/2010	67	0.33	55.1			2.31

Abbreviations: ND = No Data (data rejected due to QA/QC issues).

QC Flags: J = estimated value; due to QA/QC issues further detailed in Appendix A.

R = rejected value; due to QA/QC issues further detailed in Appendix A.

**Lewis Creek**

<b>Location</b>	<b>Date</b>	(mpn/100ml) <b>E. Coli.</b>	(ug P/L) <b>TP</b>	(mg/L) <b>TSS</b>	(NTU) <b>Turbidity</b>
LCR14	4/7/2010		115	51 J	5.68
LCR3.7	4/7/2010		33.9	13.6 J	5.67
LCR14	5/5/2010		47.9		1.92
LCR3.7	5/5/2010		54.8		5.32
LCR14	6/2/2010	866	20		1.47
LCR3.7	6/2/2010	105	27.8		2.76
LCR14	7/7/2010	236	12.9		1.74
LCR3.7	7/7/2010	88	30.1		7.08
LCR14	8/4/2010	816	25.3		4.98
LCR3.7	8/4/2010	210	52.2		17.2
LCR14	9/1/2010	387	20.5		1.54
LCR3.7	9/1/2010	79	31		4.58

QC Flags: J = estimated value; due to QA/QC issues further detailed in Appendix A.



## Little Otter Creek

Location	Date	(mpn/100ml) E. Coli.	(mg-N/L) TN	(ug P/L) TP	(ug P/L) DP	(mg/L) TSS	(NTU) Turbidity
MDC1.2	4/7/10		0.57	80.2 J	82.6 J	3.4 J	6.93
LOC14.4	4/7/10		1.18	ND R	49.5 J	9.2 J	17
LOC11	4/7/10			ND R	47.8		
LOC10	4/7/10		0.61	ND R	51.1 J	4.4 J	8.07
LOC8	4/7/10			ND R	ND R	7 J	12.9
LOC7.8	4/7/10		0.52	ND R	ND R	30 J	41.8
LOC4.3	4/7/10		0.56	69.4 J	72.9 J	20.4 J	28.1
MDC1.2	5/4/10		0.64	142	121	2.27 J	2.73
LOC14.4	5/4/10		1.57	306	38.5	82.6 J	237 E
LOC10	5/4/10		0.51	60.6	43	2.58 J	3.44
LOC8	5/5/10		0.72	116	57.2	18.8 J	43.3 E
LOC7.8	5/5/10		0.72	121	46.8	19.8 J	55 E
LOC4.3	5/5/10		0.56	93.5	37.5	18.8 J	38.8
MDC1.2	6/2/10	866	0.81	134	105	3.64	7.52
LOC14.4	6/2/10	649	1.48	69.7	53.2	5.92	3.94
LOC10	6/2/10	921	1.29	116	69.7	20.2	18.3
LOC8	6/2/10	435	1.19	114	70.3	19	16.6
LOC7.8	6/2/10	461	1.06	108	64.8	9.9	17.9
LOC4.3	6/2/10	649	1.02	106	62.4	19	14.7
MDC1.2	7/7/10	687	1.04	159	115	9.68	11.2
LOC14.4	7/7/10	63	1.89	51.7	38.6	28.6	3.39
LOC10	7/7/10	76	0.98	131	83.7	18.9	20.9
LOC8	7/7/10	45	0.47	77.3	55.3	5.37	8.6
LOC7.8	7/7/10	147	0.68	83.4	37	23.5	35.8
LOC4.3	7/7/10	55	0.73	110	71.8	20.3	13.1
MDC1.2	8/4/10	326	0.97	206	143	12	15.3
LOC14.4	8/4/10	548	0.7	138		6.32	6.1
LOC10	8/4/10	1733	0.89	248	161	23.2	27.7
LOC8	8/4/10	1733	0.87	242		30.7	34.2
LOC7.8	8/4/10	1986	0.9	258		37.3	55.5
LOC4.3	8/4/10	1733	1.1	164		38.4	48.5
MDC1.2	9/1/10	> 2419.6	1.02	189	139	10.5	10.4
LOC14.4	9/1/10	79	2.52	48.3	42.2	1.35	1.24
LOC10	9/1/10	127	1.27	109	82.1	10.8	14.2
LOC8	9/1/10	248	0.92	81.6	65.4	2.98	4.55
LOC7.8	9/1/10	250	0.92	101	57.1	32.8	26.1
LOC4.3	9/1/10	81	0.57	56	48.9	2.57	5.33
LOC14.4	9/29/10			73.6	63		
LOC10	9/29/10			106	66.1		
LOC7.8	9/29/10			77.8	49		
LOC14.4	10/1/10			910	750		
LOC10	10/1/10			520	256		
LOC7.8	10/1/10			477	218		
LOC14.4	10/2/10			230	182		
LOC10	10/2/10			293	186		
LOC7.8	10/2/10			318	181		
LOC14.4	10/4/10			91	80.6		6.97
LOC10	10/4/10			152	127		17.5
LOC7.8	10/4/10			160	121		29.3

Abbreviations: ND = No Data (data rejected due to QA/QC issues).

QC Flags: J = estimated value; due to QA/QC issues further detailed in Appendix A.

R = rejected value; due to QA/QC issues further detailed in Appendix A.

## Middlebury River

Location	Date	(mpn/100ml) E. Coli.	(ug P/L) TP	(mg/L) TSS	(NTU) Turbidity
MIR5.7	4/6/2010		6.78	< 1 J	0.21
MIR1.5	4/6/2010		16.2	2.2 J	1.86
MIR5.7	5/5/2010		8.8	< 1 J	0.47
MIR1.5	5/5/2010		21.4	3.77 J	1.22
MIR5.7	6/2/2010	NP	10.6		0.49
MIR1.5	6/2/2010	613	28.8		2.33
MIR5.7	7/7/2010	19	8.85		< 0.2
MIR1.5	7/7/2010	387	23.7		2.86
MIR5.7	8/4/2010	12	9.6		0.86
MIR1.5	8/4/2010	93	21.6		2.71
MIR5.7	9/1/2010	1	11.1		< 0.2
MIR1.5	9/1/2010	222	29.2		3.39

Abbreviations: NP = Sample collected, but Not Processed at the lab.

QC Flags: J = estimated value; due to QA/QC issues further detailed in Appendix A.

## New Haven River

Location	Date	(mpn/100ml) E. Coli.	(mg-N/l) TN	(ug P/L) TP	(ug P/L) DP	(mg/L) TSS	(NTU) Turbidity
NH4.5	4/7/2010			24.9		2.95 J	0.8
NHR11.5	4/7/2010			17.2		1.3 J	0.25
NHR9	4/7/2010			20.1		1.6 J	0.22
NHR.5	5/5/2010		0.26	17.7	7.26	3.5 J	
NHR11.5	5/5/2010		0.21	8.58	< 5	1.09 J	0.3
NHR15	5/5/2010		0.19	7.01	< 5	< 1 J	0.21
NHR2	5/5/2010		0.34	17.4	6.4	2.9 J	1.04
NHR6	5/5/2010		0.26	10.1	5.05	1.09 J	0.42
NHR9	5/5/2010		0.23	10.9	5.32	1.95 J	0.32
NHR15	6/2/2010		0.21	8.87			0.26
NHR11.5	6/2/2010		0.24	8.11			0.44
NHR9	6/2/2010		0.28	8.41			0.46
NHR6	6/2/2010	54	0.36	8.27			0.46
NHR2	6/2/2010	291	0.46	27.8			5.3
NHR.5	6/2/2010	365	0.41	13.7			1.7
NHR15	7/7/2010			5.91			0.22
NHR11.5	7/7/2010			6.57			< 0.2
NHR9	7/7/2010			6.82			< 0.2
NHR6	7/7/2010	130		6.36			0.25
NHR2	7/7/2010	196		14.6			1.62
NHR.5	7/7/2010	77		11.9			1.03
NHR15	8/4/2010			8.47			0.5
NHR11.5	8/4/2010			9.68			0.59
NHR9	8/4/2010	66		8.98			1.03
NHR6	8/4/2010	120		15.9			1.29
NHR2	8/4/2010	272		24.8			4.53
NHR.5	8/4/2010	205		32.4			2.17
NHR15	9/1/2010			8.6			< 0.2
NHR1.5	9/1/2010			9.33			< 0.2
NHR9	9/1/2010			11.2			< 0.2
NHR6	9/1/2010	11		8.85			< 0.2
NHR2	9/1/2010	345		31.1			4.7
NHR.5	9/1/2010	153		13.2			1.24

QC Flags: J = estimated value; due to QA/QC issues further detailed in Appendix A.

### Otter Creek (Lower)

Location	Date	(mpn/100ml) E. Coli.	(mg-N/l) TN	(mg-N/l) NO2-NO3	(ug P/L) TP	(ug P/L) DP	(mg/L) TSS	(NTU) Turbidity
OTR21	4/7/2010				41.8		10.4 J	1.76
OTR7.3	4/7/2010				123	38.5	44.4 J	5.74
OTR21	5/4/2010		0.36	0.13	30.4	15.3	< 1 J	1.12
OTR7.3	5/5/2010		0.37	0.14	34.3	16.3	5.81 J	4.14
OTR21	6/2/2010	105	0.46		22.8			1.93
OTR7.3	6/2/2010	72	0.44		25.5			2.96
OTR21	7/7/2010	39	0.5		28			2.57
OTR7.3	7/7/2010	42	0.49		39.5			4.97
OTR21	8/4/2010	40	0.42		29.8			3.82
OTR7.3	8/4/2010	344	0.72		80.3			48.3
OTR21	9/1/2010	35	0.43		28.8			1.38
OTR7.3	9/1/2010	22	0.42		31.5			2.16

QC Flags: J = estimated value; due to QA/QC issues further detailed in Appendix A.

## **Attachments**

- 1 Lemon Fair River – 2010 Water Quality Summary
- 2 Lewis Creek – 2010 Water Quality Summary
- 3 Little Otter Creek – 2010 Water Quality Summary
- 4 Middlebury River – 2010 Water Quality Summary
- 5 New Haven River – 2010 Water Quality Summary
- 6 Otter Creek (Lower) – 2010 Water Quality Summary

## Addison County Riverwatch Collaborative Lemon Fair River - 2010 Water Quality Summary

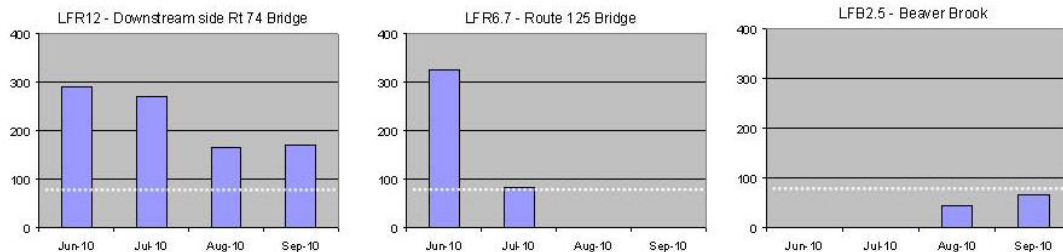
The Addison County Riverwatch Collaborative has been monitoring water quality in the Lemon Fair River since 2003. For years 2010 and 2011, the number of sampling locations in this watershed has been reduced to two sentinel stations, LFR12 and LFR6.7. Site LFR6.7 was inaccessible in August and September due to bridge construction, and a site on the upstream Beaver Brook tributary was substituted during those months (LFB2.5). During 2010, Lemon Fair sites were tested for phosphorus, nitrogen and turbidity on the first Wednesday in April and May (Spring sampling dates) and in June, July, August and September (Summer sampling dates). E.coli was tested only on the Summer dates. Flow in the river during Summer sampling was relatively low, representing baseflow to small storm conditions (based on gaging records for nearby rivers). Flows on the April and May dates were moderate, due to snow melt and spring rains.

Site	Location	Town
LFR6.7	Route 125 bridge.	Cornwall
LFR12	Downstream of Route 74 bridge	Shoreham
LFB2.5	Beaver Brook, trib up from Rt 125 bridge	Cornwall

**E.coli** concentrations in the Lemon Fair at the Route 74 bridge site (LFR12) were above the state standard of 77 MPN / 100 mL on all four Summer sampling dates: June 2, July 7, August 4, and September 1. E.coli levels at the downstream station at the Route 125 bridge (LFR6.7) also exceeded the standard on June 2 and July 7. At the substitute station on Beaver Brook (LFB2.5), E. coli concentrations were below the state standard on August 4 and September 1. Detected E.coli concentrations at LFR12 and LFR6.7 were consistent with historic monitoring results. The Beaver Brook site has not historically been tested by the ACRWC.

### E.Coli

Vermont State Standard = 77 MPN / 100 mL



**Turbidity** levels in the Lemon Fair at the sampled stations ranged from 2.3 to 145 NTUs, with an average level of 56 NTUs for the six sample dates, including spring sampling dates, April 6 and May 4. Concentrations exceeded the Vermont state standard of 25 NTUs (for Class B warm-water fisheries) at LFR12 on all sample dates and at LFR6.7 on April 6 and June 2. Results for stations LFR12 and LFR6.7 were generally consistent with historic data.

**Phosphorus** was detected at moderate concentrations during the six Spring and Summer sampling dates. Concentrations ranged from 50 to 260 ug/L, with an average of 140 ug/L. The mean of the Summer, low-flow, sample results at each station exceeded the recently proposed instream phosphorus criteria of 44 ug/L for warm-water medium gradient (WWMG) Wadeable Stream Ecotype in Class B waters. It should be noted that mean values for sites LFR6.7 and LFB2.5 were each developed on the basis of two sample dates only. VTDEC guidance (2009) suggests that Summer-time low-flow means should be developed on the basis of at least three samples collected on nonconsecutive days.

**Nitrogen** concentrations were generally very low (ranging from < 0.1 to 1.05 mg N / L) and well below the state standard for nitrogen as nitrate (5 mg/L). The mean of the Summer, low-flow, sample results at sites LFR12 and LFR6.7 exceeded the recently proposed instream nitrogen criteria of 0.75 mg/L for WWMG Wadeable Stream Ecotype in Class B waters (the mean for LFR6.7 was developed from two samples only).

2011: The Addison County Riverwatch Collaborative will continue to monitor for E.coli, phosphorus and turbidity at the two sentinel sites in 2011. An increased number of parameters and additional monitoring sites will be evaluated when a more intensive monitoring focus rotates back to the Lemon Fair River for a two-year period beginning in the year 2012.

For more information, contact the Lemon Fair sampling coordinator:  
Kathy Morse, 545-2859, [kmorse@middlebury.edu](mailto:kmorse@middlebury.edu)

## Addison County Riverwatch Collaborative Lewis Creek - 2010 Water Quality Summary

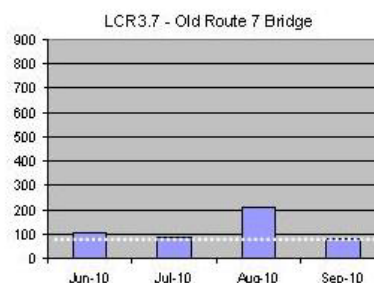
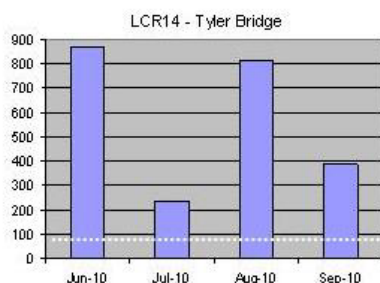
The Addison County Riverwatch Collaborative has been monitoring water quality in the Lewis Creek since 1992. For years 2010 and 2011, the number of sampling locations in this watershed has been reduced to two sentinel stations, LCR3.7 and LCR14. During 2010, these sites were tested for phosphorus and turbidity on the first Wednesday in April and May (Spring sampling dates) and in June, July, August and September (Summer sampling dates). E.coli was tested only on the Summer dates. Flow in the river during Summer sampling was relatively low, representing baseflow to small storm conditions (based on records for the USGS gage which operates just upstream of LCR3.7). Flows on the April and May dates were moderate, due to snow melt and spring rains. Daily mean flows ranged from 16 to 204 cubic feet per second.

Site	Location	Town
LCR3.7	Old Route 7 Bridge	Ferrisburgh
LCR14	Tyler Bridge	Monkton

**E.coli** concentrations in the Lewis Creek at both sampling sites exceeded the state standard of 77 MPN / 100 mL on all four Summer sampling dates: June 2, July 7, August 4, and September 1. E.coli levels at the upstream site, Tyler Bridge (LCR14), were significantly higher than the downstream site, Old Route 7 Bridge (LCR3.7). Detected E.coli concentrations at these sentinel sites in the 2010 season were largely consistent with historic monitoring results.

### E.Coli

Vermont State Standard = 77 MPN / 100 mL



**Turbidity** levels in the Lewis Creek at the sampled stations ranged from 1.5 to 17 NTUs, with a mean level of 5 NTUs for the six sample dates, including two spring sampling dates, April 7 and May 5. Except for the 17 NTU detection at LCR3.7 on August 4, turbidity levels were below the Vermont state standard of 10 NTUs (for Class B cold-water fisheries). Turbidity results for stations LCR14 and LCR3.7 were generally consistent with historic data. Median turbidity levels are generally less than 10 NTUs, except during rain events and/or moderate to high flow conditions, such as a Summer storm or during Spring runoff. Approximately 1.12 inches of rainfall were recorded at the Burlington Airport on August 2 through August 4. However, daily mean flows recorded at the USGS gaging station on Lewis Creek just upstream from LCR3.7 increased by a modest amount from 30 cfs on August 2, to 57 cfs on August 3, declining again to 30 cfs by August 6.

**Phosphorus** was detected at moderate concentrations during the six Spring and Summer sampling dates, ranging from 13 to 115 ug/L, with an average of 39 ug/L. The mean concentration of Total Phosphorus for four Summer sample dates at either site did not exceed the proposed criteria of 44 ug-P/L for the warm-water medium gradient (WWMG) Wadeable Stream Ecotype in Class B waters.

2011: The Addison County Riverwatch Collaborative will continue to monitor for E.coli, phosphorus and turbidity at these two sentinel sites in 2011. An increased number of parameters and additional monitoring sites will be evaluated when a more intensive monitoring focus rotates back to the Lewis Creek for a two-year period beginning in the year 2012.

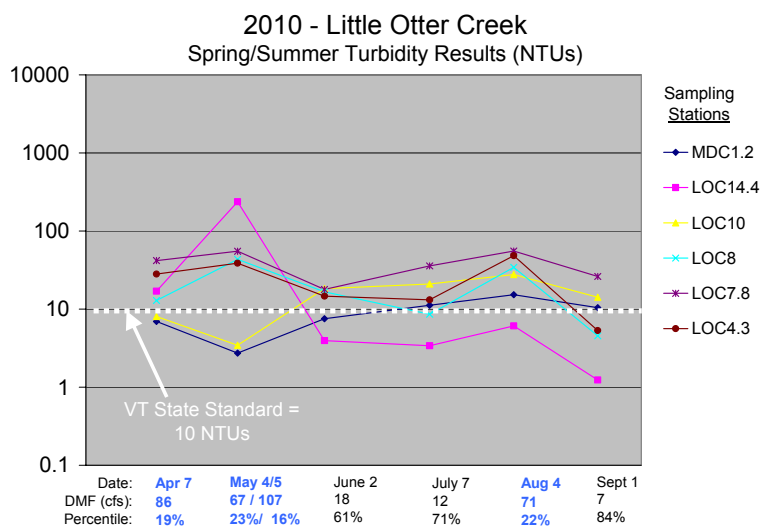
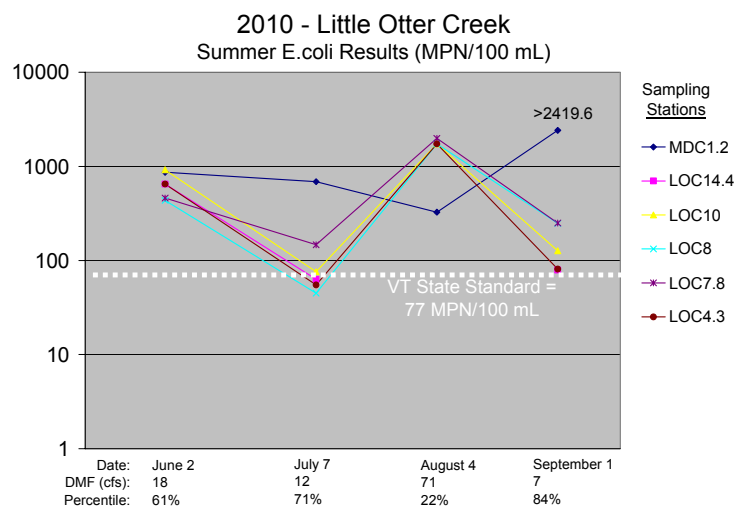
For more information, contact the Lewis Creek sampling coordinator:  
Louis DuPont, 453-5538, [ldupont@gmavt.net](mailto:ldupont@gmavt.net)

## Addison County Riverwatch Collaborative Little Otter Creek - 2010 Water Quality Summary

The Addison County Riverwatch Collaborative has been monitoring water quality in the Little Otter Creek since 1997. During 2010, six sites were tested for phosphorus, nitrogen and turbidity on the first Wednesday in April and May (Spring sampling dates) and in June, July, August and September (Summer sampling dates). E.coli was tested only on the Summer dates. Flow in the river during 3 of the 4 Summer sampling dates was relatively low, representing baseflow to small storm conditions (based on records for the USGS gage on Little Otter Creek near the Route 7 crossing). Flows on the April, May and August dates were moderate, due to snow melt and rain events.

Site	Location	Town
LOC14.4	Plank Rd.	New Haven
LOC10	Monkton Road	Ferrisburgh
LOC8	Wing Rd bridge	Ferrisburgh
LOC7.8	Middlebrook Rd (North)	Ferrisburgh
LOC4.3	Route 7 Bridge	Ferrisburgh
MDC1.2	Wing Rd./Middlebrook Rd. (South)	Ferrisburgh

**E.coli** concentrations in the Little Otter Creek stations were well above the state standard of 77 MPN / 100 mL on all four sample dates: June 2, July 7, August 4, and September 1 – except for a few stations (LOC4.3, LOC8, LOC10, and LOC14.4) on July 7. Flows on the June, July and September sample dates were very low, ranging from 7 to 18 cfs. Flow during the August 4 event was moderate in response to 1.12 inches of rain which fell on August 2 – 4 (as recorded at the Burlington Airport). Daily mean flows in the Little Otter Creek, as measured at the USGS gage near LOC4.3, rose from 13 cfs on August 2 to a maximum of 94 cfs on August 5, and slowly declined to 15 cfs by August 8. E.coli concentrations detected at these stations during 2010 are relatively consistent with historic monitoring results. LOC10 is a new sampling station for which there are no historic data. Mud Creek station (MDC1.2) has traditionally had elevated E.coli as it is located directly downstream of a dairy pasture where livestock have direct access to the stream.



**Turbidity** levels in the Little Otter Creek at the six stations were moderate to high and often exceeded the Vermont standard of 10 NTUs (for Class B cold-water fisheries). Values ranged from 1.2 to 237 NTUs, with a mean level of 25 NTUs for the six sample dates, including the two spring sampling dates on April 7 and May 4/5. Samples were collected on May 4 at MDC1.2, LOC14.4 and LOC10, while the remaining stations were sampled on May 5. The high Turbidity value at LOC14.4 (237 NTUs) may represent an outlier; this result was flagged "E" by the laboratory. Such a high value has not been detected previously at this station (turbidity

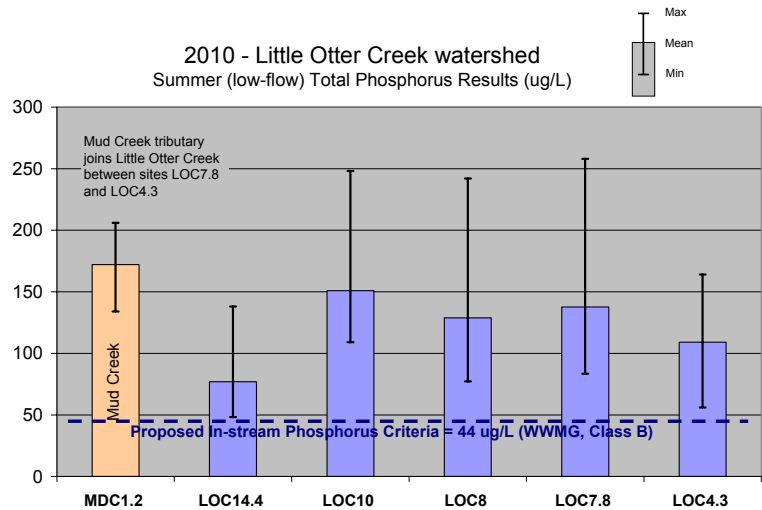
sampling in the Little Otter Creek was conducted previously in 2008). However, Total Suspended Solids were also elevated at this station on the May 4 sample date. A total of 0.51 inch of precipitation was recorded on May 3 – 4 at the Burlington Airport. Based on a separate flow monitoring study, the headwaters of Little Otter



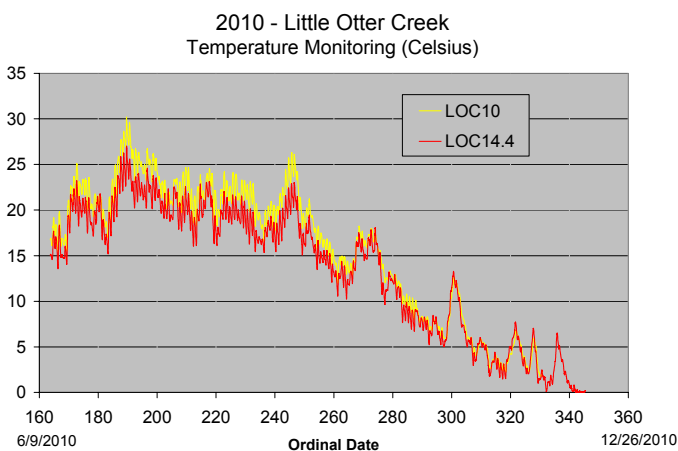
Creek (upstream of LOC14.4) exhibit a flashier response to precipitation than the middle and lower portions of the watershed. Geomorphic assessments in the mile of river channel upstream of LOC14.4 identified significant streambank erosion and recent channel adjustments. Therefore, it is possible that the May 4 sample at LOC14.4 captured a local turbidity event.

**Phosphorus** levels were detected at relatively low concentrations during the six Spring and Summer sampling dates. Concentrations ranged from 48 to 306 ug/L, with an average of 131 ug/L for the May through September sample dates (due to quality control issues, April sample results for Total Phosphorus were qualified). A somewhat elevated concentration of Total Phosphorus was detected at LOC14.4 on May 4 (306 ug/L) – the same sample for which elevated Turbidity and TSS were reported. As discussed above, the May 4 sample date coincided with a Spring precipitation event that resulted in a moderate-flow condition in Little Otter Creek (daily mean flow of 67 cfs near LOC4.3 on May 4).

Total Phosphorus concentrations detected in 2010 were generally consistent with historic data. Moderate to high concentrations of Total Phosphorus have been recorded in past years at times of high flow and runoff. Vermont recently proposed in-stream phosphorus criteria for aquatic life and aesthetics uses in wadeable streams (VTDEC, 2009). The mean concentration of Total Phosphorus for four Summer sample dates exceeded the proposed criteria of 44 ug-P/L for the warm-water medium gradient (WWMG) wadeable stream ecotype in Class B waters.



**Nitrogen** concentrations in the Little Otter Creek were very low (ranging from 0.47 to 2.5 mg-N/L) and below the state standard for nitrogen as nitrate (5 mg/L). Vermont recently proposed in-stream nitrogen criteria for aquatic life and aesthetics uses in wadeable streams (VTDEC, 2009). The mean concentration of Total Nitrogen for the four Summer sample dates exceeded the proposed criteria of 0.75 mg-N/L for the warm-water medium gradient (WWMG) wadeable stream ecotype in Class B waters.



**Temperature** was monitored at two stations on the Little Otter Creek (LOC14.4 and LOC10) during 2010 as part of a separate flow study. Data loggers installed at these sites recorded temperature at 15-minute intervals. Temperatures at both sites exceeded 20 degrees Celsius for several days during the mid-Summer months. Temperature at downstream site LOC10 was consistently higher than upstream site LOC14.4 during July, August, and September. The Little Otter Creek channel between these sites is characterized by minimal forested buffers and extensive wetlands.

2011: For years 2010 and 2011, the Little Otter Creek watershed is the subject of focused monitoring, including a flow study to evaluate nutrient and sediment loading.

For more information, contact the Little Otter Creek sampling coordinator:  
Craig Miner, 877-2469, [newminer1974@msn.com](mailto:newminer1974@msn.com)

## Addison County Riverwatch Collaborative Middlebury River - 2010 Water Quality Summary

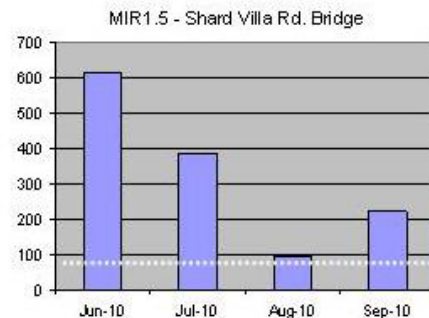
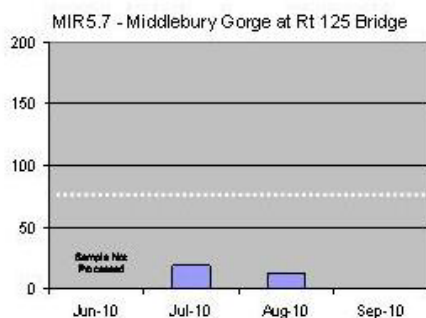
The Addison County Riverwatch Collaborative has been monitoring water quality in the Middlebury River since 1993. For years 2010 through 2013, this watershed has been identified for a reduced frequency of monitoring at two sentinel stations, MIR1.5 and MIR5.7. During 2010, these sites were tested for phosphorus and turbidity on the first Wednesday in April and May (Spring sampling dates) and in June, July, August and September (Summer sampling dates). E.coli was tested only on the Summer dates. Flow in the river during Summer sampling was relatively low, representing baseflow to small storm conditions (based on gaging records for nearby rivers). Flows on the April and May dates were moderate, due to snow melt and spring rains.

Site	Location	Town
MIR1.5	Shard Villa Rd. Bridge	Middlebury
MIR5.7	Midd. Gorge @ Rte 125 Bridge	Middlebury

**E.coli** concentrations at the Middlebury Gorge near the Route 125 bridge (MIR5.7) were well below the state standard of 77 MPN / 100 mL on three sample dates: July 7, August 4, and September 1. The June 2 sample was unable to be processed at the lab. E.coli concentrations at the downstream station at Shard Villa Road bridge (MIR1.5) were well above the state standard on all four summer sampling dates. These results are generally consistent with historic Summer sampling results, which have shown an increase in E.coli levels downstream of the Route 7 bridge.

### E.Coli

Vermont State Standard = 77 MPN / 100 mL



**Turbidity** levels in the Middlebury River were generally low and below the Vermont state standard of 10 NTUs (for Class B cold-water fisheries). Values ranged from < 0.2 to 3.4 NTUs, with an average level of 2.1 NTUs for the four summer sample dates at the two sites. An average of 1.6 NTUs is calculated if all six sample dates are considered, including the two spring sampling dates on April 6 and May 5. Results are consistent with historic trends, which indicate an increasing level of turbidity with distance downstream of the Route 7 bridge during baseflow to low-flow conditions. Based on past years' sampling results, Turbidity can increase well above the state standard at times of high flow – during a Summer thunderstorm, or during Spring runoff conditions – particularly in the lower section of the river below the Route 7 bridge.

**Phosphorus** levels were detected at relatively low concentrations during the six Spring and Summer sampling dates. Concentrations ranged from 7 to 29 ug/L, with an average of 16 ug/L. Moderately high concentrations of Total Phosphorus have been recorded in past years at times of high flow and runoff. Historically, Total Phosphorus concentrations have increased between the Munger Street bridge in New Haven (NHR 5) and the confluence of Muddy Branch (NHR 2).

2011: The Addison County Riverwatch Collaborative will continue to monitor for E.coli, phosphorus and turbidity at these two sentinel sites in 2011. An increased number of parameters and additional monitoring sites will be evaluated when a more intensive monitoring focus rotates back to the Middlebury River for a two-year period beginning in the year 2014.

For more information, contact the Middlebury River sampling coordinator:  
Heidi Willis, 352-4327, [redsprings@nbnworks.net](mailto:redsprings@nbnworks.net)

## Addison County Riverwatch Collaborative New Haven River - 2010 Water Quality Summary

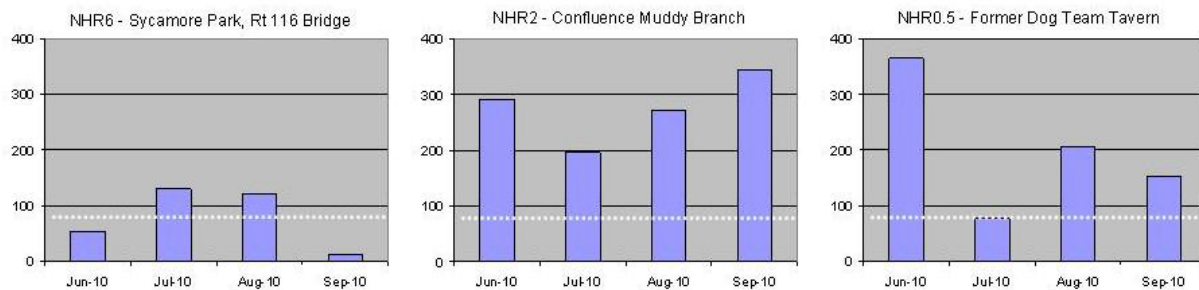
The Addison County Riverwatch Collaborative has been monitoring water quality in the New Haven River since 1993. During the Summer of 2010, six locations within the New Haven River were tested for phosphorus and turbidity on the first Wednesday in April and May (Spring sampling dates) and in June, July, August and September (Summer season). Three of these locations (NHR6, NHR2, and NHR.5) were tested on the same Summer dates for E.coli. Flow in the river during Summer sampling was relatively low, representing baseflow to small storm conditions (based on records from the USGS gage on the New Haven River at Brooksville, just upstream from NHR.5). Flows on the April and May dates were moderate, due to snow melt and spring rains.

Site	Location	Town
NHR.5	Former Dog Team Tavern	New Haven
NHR2	Muddy Branch confluence	New Haven
NHR6	Route 116 Bridge, Sycamore Park	Bristol
NHR9	South St. Bridge	Bristol
NHR11.5	Bartlett's Falls Pool	Bristol
NHR15	S. Lincoln Bridge (Gap Rd.)	Lincoln

**E.coli** concentrations at Sycamore Park (NHR6) were above the state standard of 77 MPN / 100 mL on two sample dates, July 7 and August 4, but below the standard on June 2 and September 1. At the downstream stations, near the Nash Farm at the confluence of Muddy Branch (NHR2) and near the former Dog Team Tavern (NHR.5), E. coli was detected at or above the standard on all four sample dates. Detected E.coli concentrations were generally consistent with historic results which have indicated an increase in levels downstream of the Munger Street bridge.

### E.Coli

Vermont State Standard = 77 MPN / 100 mL



**Turbidity** levels in the New Haven River were generally low and below the Vermont state standard of 10 NTUs (for Class B cold-water fisheries). Values ranged from 0.2 to 5.3 NTUs, with an average level of 1.2 NTUs for the six sample dates at the six sites, including Spring sample dates, April 7 and May 4. Results indicate a slight increasing trend in turbidity with distance downstream. Based on past years' sampling results, Turbidity can increase well above the standard at times of increased flow – during a Summer thunderstorm, or during Spring runoff conditions – especially in the lower section of the river below the Bristol Flats.

**Phosphorus** was detected at relatively low concentrations during the Spring and Summer sampling dates. Concentrations ranged from 6 to 32 ug/L, with an average of 13 ug/L. Moderately high concentrations of Total Phosphorus have been detected at times of high flow and runoff in past years. Historically, Total Phosphorus concentrations have increased between the Munger Street bridge in New Haven (NHR 5) and the confluence of Muddy Branch (NHR 2).

2011: The Addison County Riverwatch Collaborative plans to work cooperatively with the New Haven River Anglers to increase assessments in the Muddy Branch tributary which drains the northern portion of Middlebury and joins the New Haven River at the Nash Farm (near NHR2). The Muddy Branch drains a 17 square mile area (14.6% of the total watershed), and contains 27% agricultural land use. Also, the Town of Bristol (Conservation Commission) has received a Clean & Clear Grant to develop restoration and conservation projects and update geomorphic assessments in the watershed. The focus of this study will be the New Haven River main stem in Bristol and New Haven, as well as the lower reaches of Baldwin Creek.

For more information, contact the New Haven River sampling coordinator:  
Pete Diminico, 453-3899, [diminico@gmavt.net](mailto:diminico@gmavt.net)

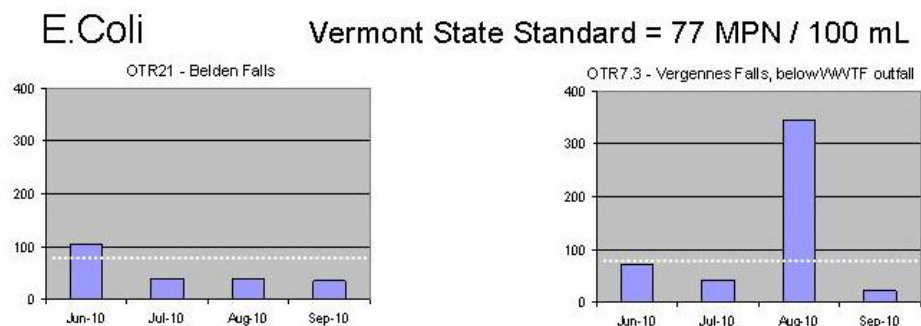
## Addison County Riverwatch Collaborative Otter Creek - 2010 Water Quality Summary

The Addison County Riverwatch Collaborative has been monitoring water quality in the lower Otter Creek since 1992. For years 2010 through 2013, the number of sampling locations in this watershed has been reduced to two sentinel stations, OTR21 and OTR7.3. During 2010, these sites were tested for phosphorus and turbidity in the first week of April and May (Spring sampling dates) and June, July, August and September (Summer sampling dates).

Site	Location	Town
OTR21	Belden Falls	New Haven
OTR7.3	Vergennes Falls/below outfall	Vergennes

E.coli was tested only on the Summer dates. Flow in the river during Summer sampling was relatively low, representing baseflow to small storm conditions (based on records for the USGS gage on Otter Creek at Middlebury). Flows on the April and May dates were moderate, due to snow melt and spring rains.

**E.coli** concentrations in the Otter Creek at the Belden Falls site (OTR21) were well below the state standard of 77 MPN / 100 mL on three sample dates: July 7, August 4, and September 1. However, values for the June 2 sample exceeded the standard. E.coli counts at the downstream station at Vergennes Falls below the Vergennes wastewater treatment facility outfall (OTR7.3) were also below the state standard, except for the August 4 sample date when counts were 344 MPN/100 mL. These results suggest a significant source(s) of E.coli between the two sample stations on August 4. Approximately 1.12 inches of rain fell on August 2 – 4 as recorded at the Burlington Airport. Daily mean flows recorded in the Otter Creek (at Middlebury) do not suggest a significant increase in discharge on or in the days prior to August 4. Gauged tributaries including the New Haven River and Lewis Creek did show a modest rise in flows during those days. Tributaries joining the Otter Creek between station OTR21 and OTR7.3 include the New Haven River and the Lemon Fair River as well as various smaller streams draining agricultural and developed lands – including stormwater runoff from downtown Vergennes. Operational records for the Vergennes wastewater treatment facility during the August 2 – 4 rain event were not available to evaluate whether this facility may have contributed to E.coli in the Otter Creek on August 4. E.coli concentrations detected at these sentinel stations during 2010 are relatively consistent with historic monitoring results.



**Turbidity** levels in the Otter Creek at the two sentinel stations were generally low and below the Vermont state standard of 25 NTUs (for Class B warm-water fisheries), except for the August 4 sample at OTR7.3 where a value of 48 NTUs was reported. If the August sample from OTR7.3 is not included, values ranged from 1.1 to 5.7 NTUs, with a mean level of 3.0 NTUs for the six sample dates, including the two spring sampling dates on April 7 and May 4/5. Results are consistent with historic data, which indicate that median turbidity values are generally less than 10 NTUs. The August 4 increase in turbidity levels between sites OTR21 and OTR7.3 coincides with the increase in E.coli concentration.

**Phosphorus** levels were detected at relatively low concentrations during the six Spring and Summer sampling dates. Concentrations ranged from 23 to 123 ug/L, with an average of 43 ug/L. A somewhat elevated concentration of Total Phosphorus was detected at OTR7.3 on April 7 (123 ug/L) and on August 4 (80 ug/L). Moderate to high concentrations of Total Phosphorus have been recorded in past years at times of high flow and runoff. As discussed above, the August 4 sample date coincided with a Summer storm that resulted in approximately 1.14 inches of rain over a three-day period from August 2 – August 4 (as recorded at Burlington Airport), but which represented low-flow conditions in Otter Creek (daily mean flow of 366 cfs at Middlebury). This rain resulted in a very minor rise in daily mean flow in the Otter Creek (to 431 cfs) by August 6. The

April 7 sample event, however, coincided with moderately high flows in the Otter Creek (daily mean flow of 3,760 cfs at Middlebury) associated with snow melt and recent spring rains (0.42 inch on April 6-7 recorded at Burlington Airport).

2011: The Addison County Riverwatch Collaborative will continue to monitor for E.coli, phosphorus and turbidity at these two sentinel sites in 2011. An increased number of parameters and additional monitoring sites will be evaluated when a more intensive monitoring focus rotates back to the Otter Creek for a two-year period beginning in the year 2014.

For more information, contact the Otter Creek sampling coordinator:  
Heidi Willis, 352-4327, [redsprings@nbnworks.net](mailto:redsprings@nbnworks.net)